MITSUBISHI ELECTRIC

Motion Controller

User's Manual

A173UHCPU, A172SHCPUN, A171SHCPUN

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Version B

MITSUBISHI ELECTRIC INDUSTRIAL AUTOMATION

INTORODUCTION

Thank you for purchasing the Mitsubishi Motion Controller/A173UHCPU/A172SHCPUN/A171SHCPUN. This instruction manual describes the handing and precautions of this unit. Incorrect handing will lead to unforeseen events, so we ask that you please read this manual thoroughly and use the unit correctly. Please make sure that this manual is delivered to the final user of the unit and that it is stored for future reference.

Precautions for Safety

Please read this instruction manual and enclosed documents before starting installation, operation, maintenance or inspections to ensure correct usage. Thoroughly understand the machine, safety information and precautions before starting operation.
The safety precautions are ranked as "Warning" and "Caution" in this instruction manual.

⚠ WARNING	When a dangerous situation may occur if handling is mistaken leading to fatal or major injuries.
⚠ CAUTION	When a dangerous situation may occur if handling is mistaken leading to medium or minor injuries, or physical damage.

Note that some items described as cautions may lead to major results depending on the situation. In any case, important information that must be observed is described.

For Sate Operations

1. Prevention of electric shocks

WARNING
Never open the front case or terminal covers while the power is ON or the unit is running, as this may lead to electric shocks.
Never run the unit with the front case or terminal cover removed. The high voltage terminal and charged sections will be exposed and may lead to electric shocks.
Never open the front case or terminal cover at times other than wiring work or periodic inspections even if the power is OFF. The insides of the control unit and servo amplifier are charged and may lead to electric shocks.
When performing wiring work or inspections, turn the power OFF, wait at least ten minutes, and then check the voltage with a tester, etc. Failing to do so may lead to electric shocks.
Always ground the control unit, servo amplifier and servomotor with Class 3 grounding. Do not ground commonly with other devices.
The wiring work and inspections must be done by a qualified technician.
Wire the units after installing the control unit, servo amplifier and servomotor. Failing to do so may lead to electric shocks or damage.
Never operate the switches with wet hands, as this may lead to electric shocks.
Do not damage, apply excessive stress, place heavy things on or sandwich the cables, as this may lead to electric shocks.
Do not touch the control unit, servo amplifier or servomotor terminal blocks while the power is ON, as this may lead to electric shocks.
Do not touch the internal power supply, internal grounding or signal wires of the control unit and servo amplifier, as this may lead to electric shocks.

2. For fire prevention

CAUTION
Install the control unit, servo amplifier, servomotor and regenerative resistor on inflammable material. Direct installation on flammable material or near flammable material may lead to fires.
If a fault occurs in the control unit or servo amplifier, shut the power OFF at the servo amplifier's power source. If a large current continues to flow, fires may occur.
When using a regenerative resistor, shut the power OFF with an error signal. The regenerative resistor may abnormally overheat due to a fault in the regenerative transistor, etc., and may lead to fires.
Always take heat measures such as flame proofing for the inside of the control panel where the servo amplifier or regenerative resistor is installed and for the wires used. Failing to do so may lead to fires.

3. For injury prevention

⚠ CAUTION
⚠ Do not apply a voltage other than that specified in the instruction manual on any terminal. Doing so may lead to destruction or damage.
⚠ Do not mistake the terminal connections, as this may lead to destruction or damage.
⚠ Do not mistake the polarity (+/-), as this may lead to destruction or damage.
⚠ The servo amplifier's heat radiating fins, regenerative resistor and servo amplifier, etc., will be hot while the power is ON and for a short time after the power is turned OFF. Do not touch these parts as doing so may lead to burns.
⚠ Always turn the power OFF before touching the servomotor shaft or coupled machines, as these parts may lead to injuries.
⚠ Do not go near the machine during test operations or during operations such as teaching. Doing so may lead to injuries.

4. Various precautions

Strictly observe the following precautions.
Mistaken handling of the unit may lead to faults, injuries or electric shocks.

(1) System structure

⚠ CAUTION
⚠ Always install a leakage breaker on the control unit and servo amplifier power source.
⚠ If installation of a magnetic contactor for power shut off during an error, etc., is specified in the instruction manual for the servo amplifier, etc., always install the magnetic contactor.
⚠ Install an external emergency stop circuit so that the operation can be stopped immediately and the power shut off.
⚠ Use the control unit, servo amplifier, servomotor and regenerative resistor with the combinations listed in the instruction manual. Other combinations may lead to fires or faults.
⚠ If safety standards (ex., robot safety rules, etc.,) apply to the system using the control unit, servo amplifier and servomotor, make sure that the safety standards are satisfied.
⚠ If the operation during a control unit or servo amplifier error and the safety direction operation of the control unit differ, construct a countermeasure circuit externally of the control unit and servo amplifier.
⚠ In systems where coasting of the servomotor will be a problem during emergency stop, servo OFF or when the power is shut OFF, use dynamic brakes.
⚠ Make sure that the system considers the coasting amount even when using dynamic brakes.
⚠ In systems where perpendicular shaft dropping may be a problem during emergency stop, servo OFF or when the power is shut OFF, use both dynamic brakes and magnetic brakes.
⚠ The dynamic brakes must be used only during emergency stop and errors where servo OFF occurs. These brakes must not be used for normal braking.
⚠ The brakes (magnetic brakes) assembled into the servomotor are for holding applications, and must not be used for normal braking.
⚠ Construct the system so that there is a mechanical allowance allowing stopping even if the stroke end limit switch is passed through at the max. speed.
⚠ Use wires and cables that have a wire diameter, heat resistance and bending resistance compatible with the system.

⚠ CAUTION
⚠ Use wires and cables within the length of the range described in the instruction manual. ⚠ The ratings and characteristics of the system parts (other than control unit, servo amplifier, servomotor) must be compatible with the control unit, servo amplifier and servomotor. ⚠ Install a cover on the shaft so that the rotary parts of the servomotor are not touched during operation. ⚠ There may be some cases where holding by the magnetic brakes is not possible due to the life or mechanical structure (when the ball screw and servomotor are connected with a timing belt, etc.). Install a stopping device to ensure safety on the machine side.

(2) Parameter settings and programming

⚠ CAUTION
⚠ Set the parameter values to those that are compatible with the control unit, servo amplifier, servomotor and regenerative resistor model and the system application. The protective functions may not function if the settings are incorrect. ⚠ The regenerative resistor model and capacity parameters must be set to values that conform to the operation mode, servo amplifier and servo power unit. The protective functions may not function if the settings are incorrect. ⚠ Set the mechanical brake output and dynamic brake output validity parameters to values that are compatible with the system application. The protective functions may not function if the settings are incorrect. ⚠ Set the stroke limit input validity parameter to a value that is compatible with the system application. The protective functions may not function if the setting is incorrect. ⚠ Set the servomotor encoder type (increment, absolute position type, etc.) parameter to a value that is compatible with the system application. The protective functions may not function if the setting is incorrect. ⚠ Set the servomotor capacity and type (standard, low-inertia, flat, etc.) parameter to values that are compatible with the system application. The protective functions may not function if the settings are incorrect. ⚠ Set the servo amplifier capacity and type parameters to values that are compatible with the system application. The protective functions may not function if the settings are incorrect. ⚠ Use the program commands for the program with the conditions specified in the instruction manual. ⚠ Set the sequence function program capacity setting, device capacity, latch validity range, I/O assignment setting, and validity of continuous operation during error detection to values that are compatible with the system application. The protective functions may not function if the settings are incorrect. ⚠ Some devices used in the program have fixed applications, so use these with the conditions specified in the instruction manual. ⚠ The input devices and data registers assigned to the link will hold the data previous to when communication is terminated by an error, etc. Thus, an error correspondence interlock program specified in the instruction manual must be used. ⚠ Use the interlock program specified in the special function unit's instruction manual for the program corresponding to the special function unit.

(3) Transportation and installation

⚠ CAUTION

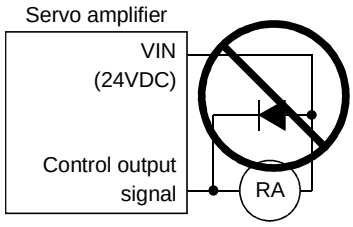
- ⚠ Transport the product with the correct method according to the weight.
- ⚠ Use the servomotor suspension bolts only for the transportation of the servomotor. Do not transport the servomotor with machine installed on it.
- ⚠ Do not stack products past the limit.
- ⚠ When transporting the control unit or servo amplifier, never hold the connected wires or cables.
- ⚠ When transporting the servomotor, never hold the cables, shaft or detector.
- ⚠ When transporting the control unit or servo amplifier, never hold the front case as it may fall off.
- ⚠ When transporting, installing or removing the control unit or servo amplifier, never hold the edges.
- ⚠ Install the unit according to the instruction manual in a place where the weight can be withstood.
- ⚠ Do not get on or place heavy objects on the product.
- ⚠ Always observe the installation direction.
- ⚠ Keep the designated clearance between the control unit or servo amplifier and control panel inner surface or the control unit and servo amplifier, control unit or servo amplifier and other devices.
- ⚠ Do not install or operate control units, servo amplifiers or servomotors that are damaged or that have missing parts.
- ⚠ Do not block the intake/outtake ports of the servomotor with cooling fan.
- ⚠ Do not allow conductive matter such as screw or cutting chips or combustible matter such as oil enter the control unit, servo amplifier or servomotor.
- ⚠ The control unit, servo amplifier and servomotor are precision machines, so do not drop or apply strong impacts on them.
- ⚠ Securely fix the control unit and servo amplifier to the machine according to the instruction manual. If the fixing is insufficient, these may come off during operation.
- ⚠ Always install the servomotor with reduction gears in the designated direction. Failing to do so may lead to oil leaks.
- ⚠ Store and use the unit in the following environmental conditions.

Environment	Conditions	
	Control unit/servo amplifier	Servomotor
Ambient temperature	0°C to +55°C (With no freezing)	0°C to +40°C (With no freezing)
Ambient humidity	According to each instruction manual.	80%RH or less (With no dew condensation)
Storage temperature	According to each instruction manual.	−20°C to +65°C
Atmosphere	Indoors (where not subject to direct sunlight). No corrosive gases, flammable gases, oil mist or dust must exist	
Altitude	1000m (3278.69ft.) or less above sea level	
Vibration	According to each instruction manual	

⚠ CAUTION
⚠ When coupling with the synchronization encoder or servomotor shaft end, do not apply impact such as by hitting with a hammer. Doing so may lead to detector damage. ⚠ Do not apply a load larger than the tolerable load onto the servomotor shaft. Doing so may lead to shaft breakage. ⚠ When not using the unit for a long time, disconnect the power line from the control unit or servo amplifier. ⚠ Place the control unit and servo amplifier in static electricity preventing vinyl bags and store. ⚠ When storing for a long time, please consult our sales representative.

(4) Wiring

⚠ CAUTION
⚠ Correctly and securely wire the wires. Reconfirm the connections for mistakes and the terminal screws for tightness after wiring. Failing to do so may lead to run away of the servomotor. ⚠ After wiring, install the protective covers such as the terminal covers to the original positions. ⚠ Do not install a phase advancing capacitor, surge absorber or radio noise filter (option FR-BIF) on the output side of the servo amplifier. ⚠ Correctly connect the output side (terminals U, V, W). Incorrect connections will lead the servomotor to operate abnormally. ⚠ Do not connect a commercial power supply to the servomotor, as this may lead to trouble. ⚠ Do not mistake the direction of the surge absorbing diode installed on the DC relay for the control signal output of brake signals, etc. Incorrect installation may lead to signals not being output when trouble occurs or the protective functions not functioning. ⚠ Do not connect or disconnect the connection cables between each unit, the encoder cable or sequence expansion cable while the power is ON. ⚠ Securely tighten the cable connector fixing screws and fixing mechanisms. Insufficient fixing may lead to the cables combing off during operation. ⚠ Do not bundle the power line or cables.



(5) Trial operation and adjustment

⚠ CAUTION
⚠ Confirm and adjust the program and each parameter before operation. Unpredictable movements may occur depending on the machine. ⚠ Extreme adjustments and changes may lead to unstable operation, so never make them. ⚠ When using the absolute position system function, on starting up, and when the controller or absolute value motor has been replaced, always perform a home position return.

(6) Usage methods

⚠ CAUTION

⚠ Immediately turn OFF the power if smoke, abnormal sounds or odors are emitted from the control unit, servo amplifier or servomotor.

⚠ Always execute a test operation before starting actual operations after the program or parameters have been changed or after maintenance and inspection.

⚠ The units must be disassembled and repaired by a qualified technician.

⚠ Do not make any modifications to the unit.

⚠ Keep the effect or magnetic obstacles to a minimum by installing a noise filter or by using wire shields, etc. Magnetic obstacles may affect the electronic devices used near the control unit or servo amplifier.

⚠ When using the CE Mark-compliant equipment, refer to the "EMC Installation Guidelines" (data number IB(NA)-67339) for the motion controllers and refer to the corresponding EMC guideline information for the servo amplifiers, inverters and other equipment.

⚠ Use the units with the following conditions.

Item	Conditions		
	A1S61PN	A1S62PN	CPU module's built-in power supply
Input power	100 to 240VAC $^{+10\%}_{-15\%}$ (85 to 264VAC)		
Input frequency	50/60Hz ± 5%		
Tolerable momentary power failure	Within 20ms		

(7) Remedies for errors

⚠ CAUTION

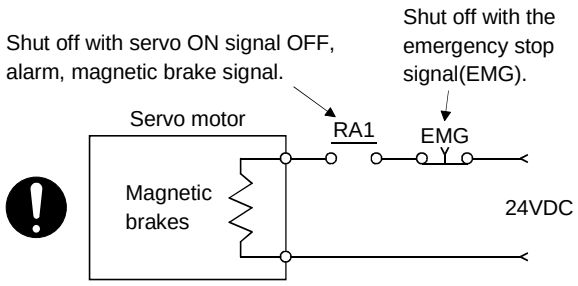
⚠ If an error occurs in the self diagnosis of the control unit or servo amplifier, confirm the check details according to the instruction manual, and restore the operation.

⚠ If a dangerous state is predicted in case of a power failure or product failure, use a servomotor with magnetic brakes or install a brake mechanism externally.

⚠ Use a double circuit construction so that the magnetic brake operation circuit can be operated by emergency stop signals set externally.

⚠ If an error occurs, remove the cause, secure the safety and then resume operation.

⚠ The unit may suddenly resume operation after a power failure is restored, so do not go near the machine. (Design the machine so that personal safety can be ensured even if the machine restarts suddenly.)



(8) Maintenance, inspection and part replacement

⚠ CAUTION
⚠ Perform the daily and periodic inspections according to the instruction manual. ⚠ Perform maintenance and inspection after backing up the program and parameters for the control unit and servo amplifier. ⚠ Do not place fingers or hands in the clearance when opening or closing any opening. ⚠ Periodically replace consumable parts such as batteries according to the instruction manual. ⚠ Do not touch the lead sections such as ICs or the connector contacts. ⚠ Do not place the control unit or servo amplifier on metal that may cause a power leakage or wood, plastic or vinyl that may cause static electricity buildup. ⚠ Do not perform a megger test (insulation resistance measurement) during inspection. ⚠ When replacing the control unit or servo amplifier, always set the new unit settings correctly. ⚠ When the controller or absolute value motor has been replaced, carry out a home position return operation using one of the following methods, otherwise position displacement could occur. 1) After writing the servo data to the PC using peripheral device software, switch on the power again, then perform a home position return operation. 2) Using the backup function of the peripheral device software, load the data backed up before replacement. ⚠ After maintenance and inspections are completed, confirm that the position detection of the absolute position detector function is correct. ⚠ Do not short circuit, charge, overheat, incinerate or disassemble the batteries. ⚠ The electrolytic capacitor will generate gas during a fault, so do not place your face near the control unit or servo amplifier. ⚠ The electrolytic capacitor and fan will deteriorate. Periodically change these to prevent secondary damage from faults. Replacements can be made by our sales representative.

(9) Disposal

⚠ CAUTION
⚠ Dispose of this unit as general industrial waste. ⚠ Do not disassemble the control unit, servo amplifier or servomotor parts. ⚠ Dispose of the battery according to local laws and regulations.

(10) General cautions

⚠ CAUTION
⚠ All drawings provided in the instruction manual show the state with the covers and safety partitions removed to explain detailed sections. When operating the product, always return the covers and partitions to the designated positions, and operate according to the instruction manual.

Revisions

*The manual number is given on the bottom left of the back cover.

Print Date	*Manual Number	Revision
Apr.1998	IB(NA)-67395-B	First edition
Sep.2000	IB(NA)-67395-C	Addition Addition of information on the A173UHCPU Correction For Sate Operations (4. Various precautions (3), (6), (8)), CONTENTS, 1.1, 1.2.1, 1.2.2, 1.3, 1.4, 1.5.1, 1.5.2 (1), 1.5.3, 1.5.4, 1.5.5, 1.5.6, 2.1, 2.3, 2.3.1, 2.3.2 (2), 4.3, 4.4, 5.4.1, 5.4.1(3), 5.4.1 (4), 5.4.1 (5), APPENDICES Delete 1.5.7 (2), 5.3.1 (2)

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1. SPECIFICATIONS OF MOTION SYSTEM COMPONENTS

This chapter provides the system configuration of the motion system and the specifications, functions, setting methods, external equipment connection methods, part names and other information of the related modules for those who are involved in the design, installation, wiring, trial run, adjustment and maintenance of the motion system.

1.1 Overview of the Motion System

A173UHCPU/A172SHCPUN/A171SHCPUN are CPUs which incorporate the positioning control CPU (hereinafter referred to as PCPU) and the sequence control CPU (hereinafter referred to as SCPU) and perform the following functions:

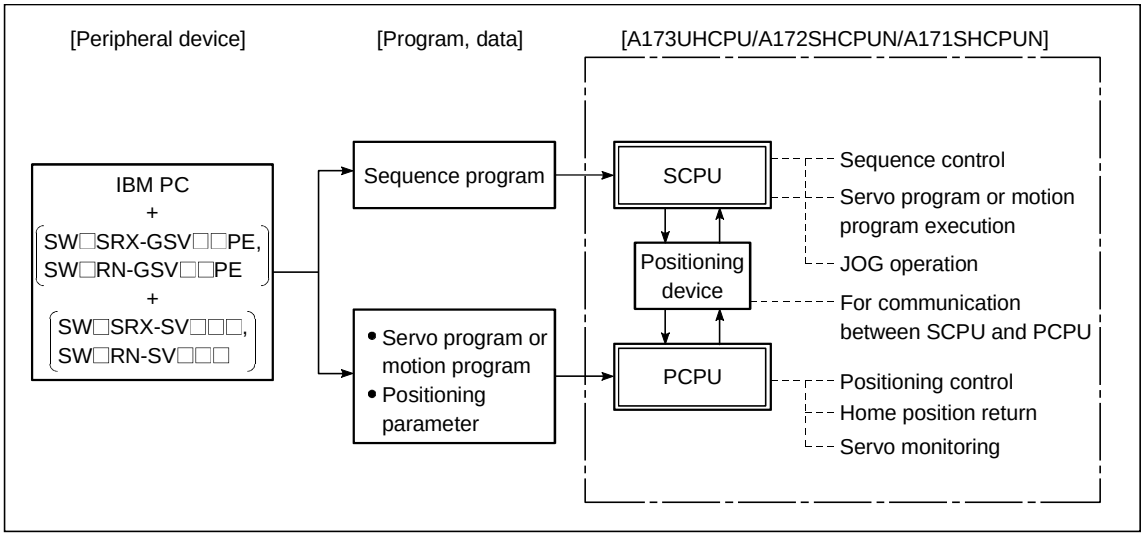
- PCPU.....Carries out the positioning control, home position return, servo amplifier control status monitoring using a servo program or motion program.
- SCPU.....Carries out the sequence control, start-up of servo program or motion program, enabling and disabling manual pulse generator operation, and jog operation.

Positioning data setting and programming of A173UHCPU/A172SHCPUN/ A171SHCPUN is performed using the following peripheral devices and positioning software package.

(1) Peripheral device
- IBM PC/AT compatible running DOS/V5.0 or higher(hereinafter abbreviated as "IBM PC")

(2) Positioning software package
- For IBM PC .....SW□SRX-GSV□□PE, SW□RN-GSV□□PE

The following diagram outlines the peripheral devices and programs using a positioning software package, data creation, and A173UHCPU/A172SHCPUN/ A171SHCPUN processing.



- The sequence program written into the SCPU, the servo program or motion program written into the PCPU, and the positioning parameters are created after starting up corresponding positioning software package by the peripheral device.
- The peripheral device started up by the positioning software package can monitor the positioning control conditions of A173UHCPU/A172SHCPUN/ A171SHCPUN, execute the servo program or motion program, and perform a test such as JOG operation.

REMARKS

For information about a peripheral device and programming information for producing a sequence program and a special function unit, refer to each manual pertaining to the individual unit.
For information about creating motion programs, refer to the programming manual of the operating system used. For information about the operation of each peripheral software package, refer to each individual operating manuals.

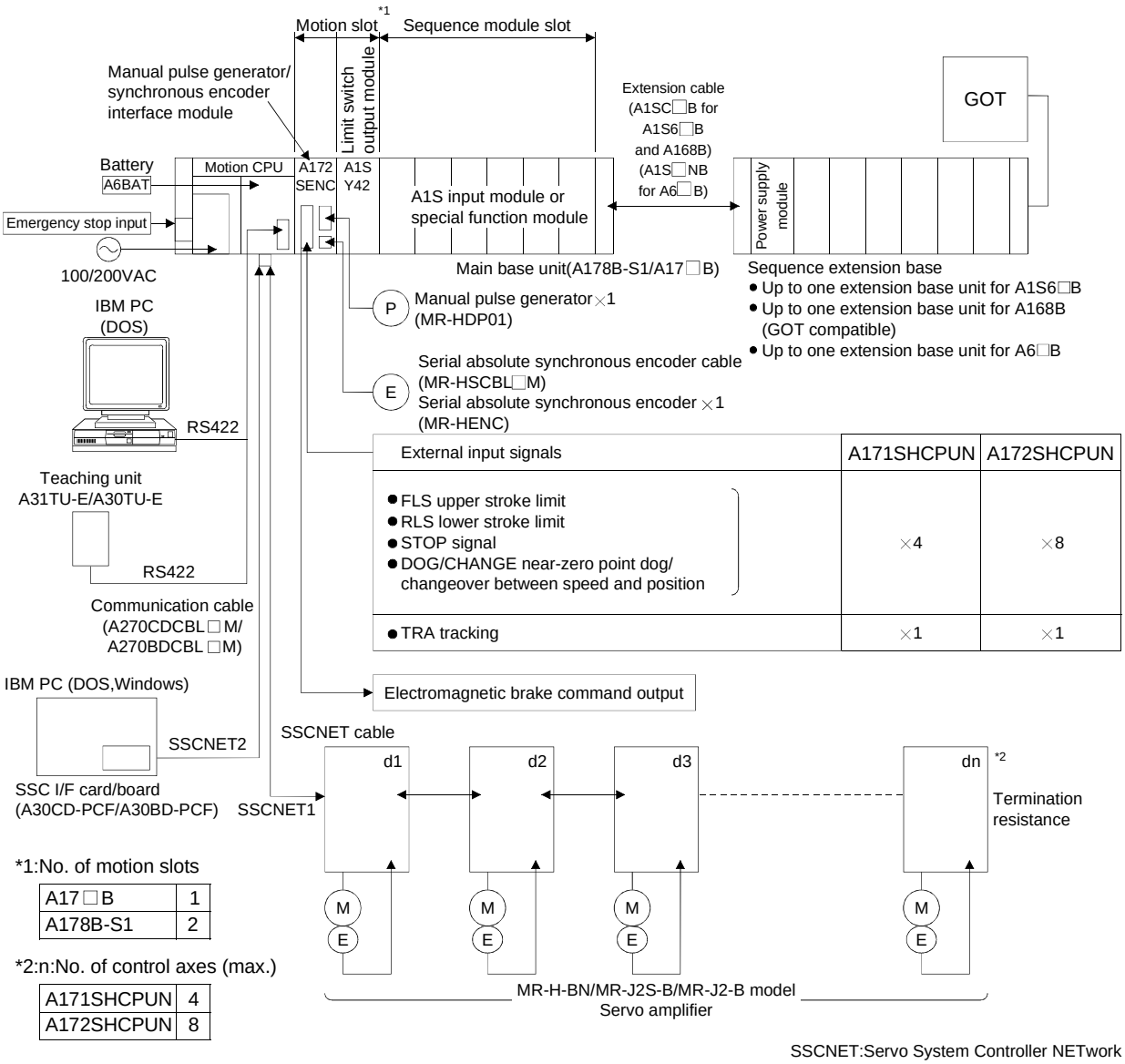
In this manual, the following abbreviations are used.

Description	Abbreviation
A173UHCPU/A172SHCPUN/ A171SHCPUN Module	A173UHCPU/A172SHCPUN/ A171SHCPUN or CPU module
MR-H-BN,MR-J2S-B,MR-J2-B servo amplifier	MR-H-BN/MR-J2S-B/MR-J2-B
A172SENC manual pulse generator/synchronous encoder interface unit/module	A172SENC
Fast serial communication between motion controller and servo amplifier	SSCNET*1

*1 SSCNET: Servo System Controller NETwork

1.2 Overall Configuration of Motion System

1.2.1 A172SHCPUN/A171SHCPUN System Overall Configuration



External input signals	A171SHCPUN	A172SHCPUN
● FLS upper stroke limit ● RLS lower stroke limit ● STOP signal ● DOG/CHANGE near-zero point dog/ changeover between speed and position	×4	×8
● TRA tracking	×1	×1

Electromagnetic brake command output

*1:No. of motion slots

A17□B	1
A178B-S1	2

*2:n:No. of control axes (max.)

A171SHCPUN	4
A172SHCPUN	8

SSCNET:Servo System Controller NETwork

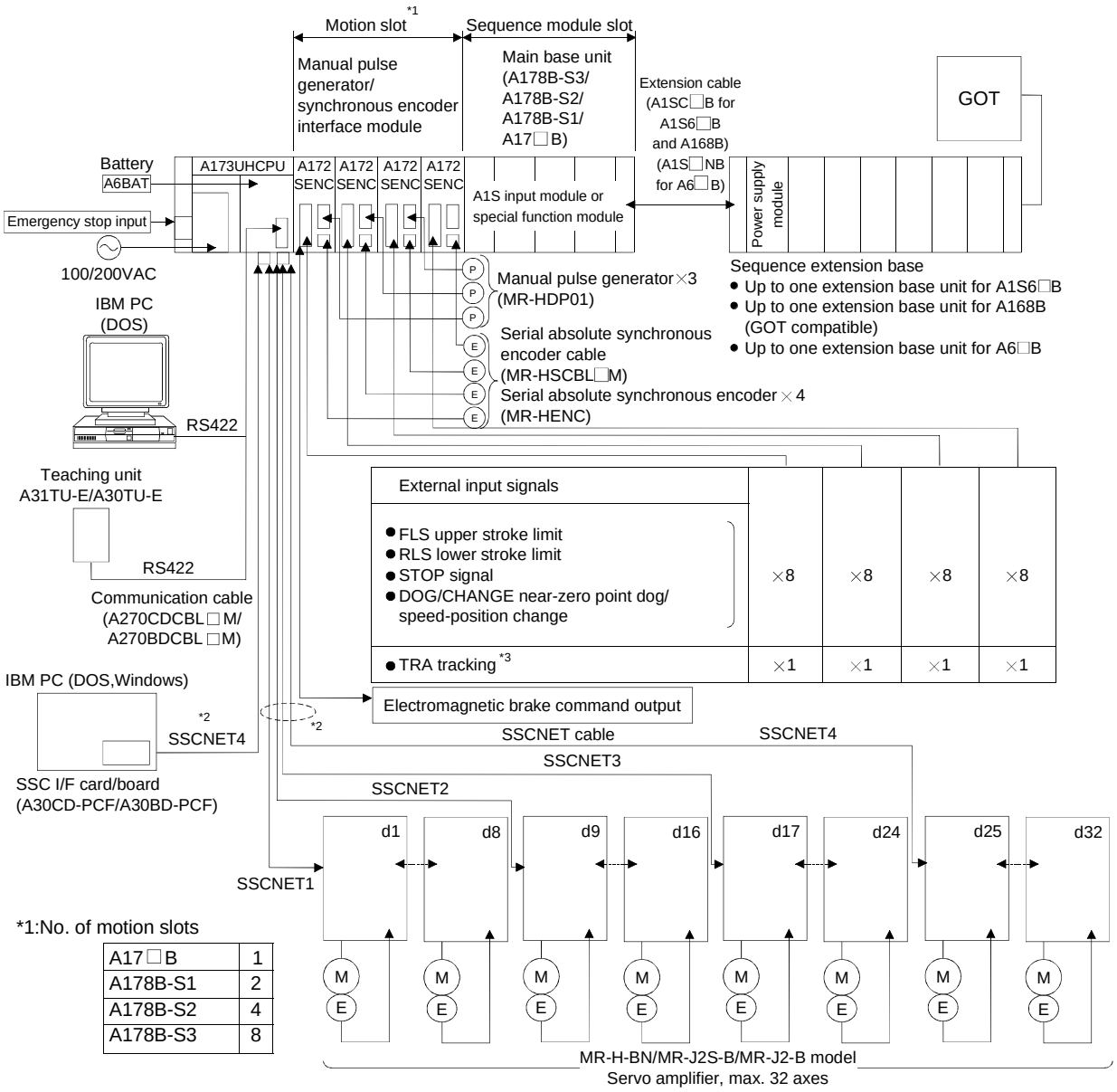
POINTS

(1) When using the sequence extension base and bus connection type GOT, select the A168B as the sequence extension base. When not using the sequence extension base, you can connect the bus connection type GOT directly to the extension connector of the main base unit.
(2) When using a teaching unit A31TU-E with a dead-man switch, a dedicated connecting cable A31TUCBL03M is required between the CPU unit and A31TU-E connector. If the A31TU-E is connected directly to the RS422 connector of the CPU without using a dedicated cable, the A31TU-E will not operate at all. After disconnecting the A31TU-E, attach a short-circuit connector A31SHORTCON for A31TUCBL.
(3) In a motion module, a sequence A1S I/O modules can also be installed.
(4) Though the external input signals of A172SENC are reserved for eight axes, for A171SHCPUN, set those for the first half four axes (PX0 to PX0F).

1. SPECIFICATIONS OF MOTION SYSTEM COMPONENTS

⚠ CAUTION
⚠ Configure safety circuits external to the controller or servo amplifier if their abnormal operation could cause axis motion in a direction other than the safe operating direction for the system. ⚠ Ensure that the characteristics of other components used in a system match those of the controllers, servo amplifiers, and servo motors. ⚠ Set the parameters to values appropriate for the controllers, servo amplifiers, servo motors, regenerative resistor types, and system application. The protective functions may not work if the parameters are set incorrectly.

1.2.2 A173UHCPU System Overall Configuration



*1:No. of motion slots

A17□B	1
A178B-S1	2
A178B-S2	4
A178B-S3	8

SSCNET:Servo System Controller NETwork

POINTS

(1) When using the sequence extension base and bus connection type GOT, select the A168B as the sequence extension base. When not using the sequence extension base, you can connect the bus connection type GOT directly to the extension connector of the main base unit.

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(3) In a motion module, a sequence A1S I/O modules can also be installed.

*2 The A173UHCPU can use four channels of the SSCNET. When using the SSCNET card/board (A30CD-PCF/A30BD-PCF), connect it to the SSCNET4 and the servo amplifiers to the SSCNET1 to 3.
In this case, up to 24 axes of servo amplifiers can be connected.

*3 TRA tracking enable can use any one point.

⚠ CAUTION
⚠ Configure safety circuits external to the controller or servo amplifier if their abnormal operation could cause axis motion in a direction other than the safe operating direction for the system. ⚠ Ensure that the characteristics of other components used in a system match those of the controllers, servo amplifiers, and servo motors. ⚠ Set the parameters to values appropriate for the controllers, servo amplifiers, servo motors, regenerative resistor types, and system application. The protective functions may not work if the parameters are set incorrectly.

1.3 Equipment in System

(1) Table of motion modules

Part Name	Model Name	Description	Current Consumption 5 VDC (A)	Remarks
CPU module	A173UHCPU(-S1)	Max. 32 axes control	1.90	
	A172SHCPUN	Max. 8 axes control	1.63	
	A171SHCPUN	Max. 4 axes control	1.63	
Main base unit	A172B	One motion module slot and one sequence module slot	—	Sequence extension connector as accessory
	A175B	One motion module slot and four sequence module slots		
	A178B	One motion module slot and seven sequence module slots		
	A178B-S1	Two motion module slots and six sequence module slots		
	A178B-S2	Four motion module slots and four sequence module slots		
	A178B-S3	Eight motion module slots and zero sequence module slots		
Sequence extension base unit	A1S65B	Extension power and five slots for system up to one extension stage	—	
	A1S68B	Extension power and eight slots for system up to one extension stage		
	A168B	Extension power and eight slots for system up to one extension stage	—	Extension connector as accessory
Extension cable	A1SC01B	Flat cable of 55 mm (2.17 in) in length	—	For extension to the right side
	A1SC03B	Length 330 mm (13 in)	—	
	A1SC07B	Length 700 mm (27 in)		
	A1SC12B	Length 1200 mm (47 in)		
	A1SC30B	Length 3000 mm (118 in)		
	A1SC60B	Length 6000 mm (236 in)		
	A1SC05NB	Length 450 mm (17 in) AnN extension base cables	—	For A6□B
	A1SC07NB	Length 700 mm (27 in) AnN extension base cables		
	A1SC30NB	Length 3000 mm (118 in) AnN extension base cables		
	A1SC50NB	Length 5000 mm (197 in) AnN extension base cables		
Manual pulse generator /synchronous encoder interface module	A172SENC	32 points I/O signals (FLS, RLS, STOP, DOG/CHANGE×8) Tracking input 1 point Electromagnetic brake control output 1 point Manual pulse generator interface 1 point Synchronous encoder interface 1 point	0.42	
Limit output unit	A1SY42	Transistor output 64 points, 12/24 VDC, 0.1A	0.93	
Manual pulse generator	MR-HDP01	4.5 VDC to 13.2 VDC 25 PLS/rev, 100 PLS/rev at magnification of 4	0.06	
Serial absolute synchronous encoder	MR-HENC	Resolution: 16384 PLS/rev, Permitted rotational speed: 4300r/min	0.15	
Serial absolute synchronous encoder cable	MR-HSCBL□M	Synchronous encoder and A172SENC connector cables: 2 m (6.56 ft.), 5 m (16.4 ft.), 10 m (32.8 ft.), 20 m (65.6 ft.), 30 m (98.4 ft.) (Same cables as encoder cables for HA-LH□K, HC-SF/RF/UF(2000r/min)series motors.)	—	
Battery	A6BAT	For CPU module memory back-up (Sequence program/servo program)	—	
Teaching unit	A30TU-E	For SV13, cable length 5 m (16.4 ft)	0.22	
	A31TU-E	For SV13 with deadman switch, cable length 5 m (16.4 ft)	0.22	
	A31TU-RE	For SV51 with deadman switch, cable length 5 m (16.4 ft) (Need A31TUCBL03M and A31SHORTCON.)	0.22	
	A31TUCBL03M	CPU module to A31TU-E connector cable of 3 m (9.84 ft.)	—	For control panel
	A31SHORTCON	Short-circuit connector for A31TUCBL		When A31TU-E is not connected
SSC I/F board	A30BD-PCF	ISA bus loading type, 2 channels/board	—	
SSC I/F card	A30CD-PCF	PCMCIA TYPE II, 1 channel/card		
SSC I/F board cable	A270BDCBL□M	3 m (9.84 ft.), 5 m (16.4 ft.), 10 m (32.8 ft.) for A30BD-PCF		
SSC I/F card cable	A270CDCBL□M	3 m (9.84 ft.), 5 m (16.4 ft.), 10 m (32.8 ft.) for A30CD-PCF		

(2) Table of servo amplifier modules

Part Name		Model Name	Description	
MR-H-BN series	Servo amplifier	MR-H□BN	50 W to 22 kW	
		MR-H□KBN	30 kW to 55 kW	
	Battery	MR-BAT	Backup for absolute position detection	
	Termination connector	MR-TM	Fitted to the last amplifier of SSCNET	
	Regenerative resistor	MR-PB□	External regenerative resistor 10 W to 500 W	
		MR-H□KB Standard accessory	Regenerative power 600 W	
		MR-PB□-4	External regenerative resistor 1300, 3900 W	
		FR-BU	Brake unit 15/30/55K	
		FR-RC	Power return converter 15/30/55K	
	SSCNET cable	MR-HBUS□M	For connection of CPU module and MR-H-BN, for connection of MR-H-BN and MR-H-BN 0.5 m(1.64 ft), 1 m (3.28ft), 5 m (16.4 ft)	
	Encoder cable *2	MR-HSCBL□M	For connection of HA-LH□K, HC-SF/RF/UF (2000r/min) series motor and MR-H-BN 2 m (16.4 ft), 5 m (16.4 ft), 10 m (32.8 ft), 20 m (65.6 ft), 30 m (98.4 ft)	
		MR-EN1CBL□M-H		
	Encoder connector set	MR-JSCNS	For HA-LH□K, HC-SF/RF/UF (2000r/min) series motors Amplifier side connector and encoder side connector set	
		MR-EN1CNS		
MR-J2S-B series	Servo amplifier	MR-J2S-□B *1	50 W to 7 kW, three-phase 200 to 230 VAC or single-phase 230 VAC	
		MR-J2S-□B1	50 W to 400 W, single-phase 100 to 120 VAC	
MR-J2-B series	Servo amplifier	MR-J2-□B	50 W to 3.5 kW	
Equipment common to MR-J2S-B and MR-J2-B series	Battery	MR-BAT	Backup for absolute position detection	
	Termination connector	MR-A-TM	Fitted to the last amplifier of SSCNET	
	SSCNET cable	MR-J2HBUS□M-A	For connection of CPU module and MR-J2S-B/MR-J2-B, for connection of MR-H-BN and MR-J2S-B/MR-J2-B 0.5 m(1.64 ft), 1 m (3.28ft), 5 m (16.4 ft)	
		MR-J2HBUS□M	For connection of MR-J2S-B/MR-J2-B and MR-J2S-B/MR-J2-B 0.5 m(1.64 ft), 1 m (3.28ft), 5 m (16.4 ft)	
	Encoder cable *2	MR-JHSCBL□M-L	Standard cable	For connection of HC-SFS/RFS/UFS (2000r/min) series motor and MR-J2S-B, and for connection of HC-SF/RF/UF (2000r/min) series motor and MR-J2-B 2 m (6.56 ft), 5 m (16.4 ft), 10 m (32.8 ft), 20 m (65.6 ft), 30 m (98.4 ft)
		MR-JHSCBL□M-H	Long flexing life cable	
		MR-ENCBL□M-H		
		MR-JCCBL□M-L	Standard cable	For connection of HC-MFS/KFS/UFS (3000r/min) series motor and MR-J2S-B, and for connection of HC-MF/UF (3000r/min), HA-FF series motor and MR-J2-B 2 m (6.56 ft), 5 m (16.4 ft), 10 m (32.8 ft), 20 m (65.6 ft), 30 m (98.4 ft)
		MR-JCCBL□M-H	Long flexing life cable	
	Encoder connector set	MR-J2CNS	For HC-SF/RF/UF (2000r/min), HC-SFS/RFS/UFS (2000r/min) series motors Amplifier side connector and encoder side connector set	
		MR-ENCNS		
		MR-J2CNM	For HC-MF/UF (3000r/min), HA-FF, HC-MFS/KFS/UFS (3000r/min) series motors Amplifier side connector and encoder side connector set	

*1: 5kW and 7kW are scheduled for release.

*2: Long distance cable or cable without connector (cable only) is also available.
Avoid using a short cable as it will cause a position shift or the like.

(3) Table of software package

(a) Motion function

Use	Peripheral Devices		Peripheral Software Package				Main OS Software Package Model Name			Teaching function
				Model Name	Applicable version		For A173UH	For A172SH	For A171SH	
					For A173UH	For A172SH/ A171SH				
For conveyor assembly (SV13)	IBM PC/AT	DOS	Japanese	SW2SRX-GSV13P	From 0AC on	00T or later	SW2SRX-SV13B	SW0SRX-SV13D	SW0SRX-SV13G	Yes
			English	SW2SRX-GSV13PE	From 00J on	00F or later				
		NT/98	Japanese	SW3RNC-GSV	From 00F on	00E or later	SW2SRX-SV13B	SW2SRX-SV13D	SW0SRX-SV13G	
			English	SW3RNC-GSVE	Without restriction	Without restriction				
For motion SFC-compatible conveyor assembly (SV13)	IBM PC/AT	NT/98	Japanese	SW3RNC-GSV	From 00F on	Without restriction	SW3RN-SV13B	SW3RN-SV13D	—	
			English	SW3RNC-GSVE	Without restriction	Without restriction				
For automatic machinery (SV22)	IBM PC/AT	DOS	Japanese	SW2SRX-GSV22P	From 0AC on	00T or later	SW2SRX-SV22A	SW0SRX-SV22C	SW0SRX-SV22F	No
				SW0SRX-CAMP	From 00B on	00B or later				
			English	SW2SRX-GSV22PE	From 00J on	00F or later				
				SW0IX-CAMPE	Without restriction	Without restriction				
		NT/98	Japanese	SW3RNC-GSV	From 00F on	00E or later				
			English	SW3RNC-GSVE	Without restriction	Without restriction				
For motion SFC-compatible automatic machinery (SV22)	IBM PC/AT	NT/98	Japanese	SW3RNC-GSV	From 00F on	Without restriction	SW3RN-SV22A	SW3RN-SV22C	—	
			English	SW3RNC-GSVE	Without restriction	Without restriction				
For machine tool peripheral (SV43)	IBM PC/AT	DOS	Japanese	SW2SRX-GSV43P	From 00T on	00J or later	SW2SRX-SV43A	SW0SRX-SV43C	SW0SRX-SV43F	No
For dedicated robot (SV51)	IBM PC/AT	DOS	Japanese	SW2SRX-GSV51P	—	00E or later	—	SW0SRX-SV51D	SW0SRX-SV51G	Yes

1.4 General Specifications

Table 1.1 Generation Specifications

Item	Specification				
Operating ambient temperature	0 to 55°C				
Storage ambient temperature	-20 to 75°C				
Operating ambient humidity	10% to 90%RH, no condensation				
Storage ambient humidity	10% to 90%RH, no condensation				
Vibration resistance	Conforms to JIS C 0911*2	Frequency	Acceleration	Amplitude	Number of Sweeps
		10 to 55Hz	—	0.075mm (0.003 in)	10 (1 octave/minute)*1
		55 to 150Hz	9.8m/s^2	—	
Shock resistance	Conforms to JIS C 0912 (98m/s^2 (10g), 3 directions, 3 times)*2				
Noise resistance	(1) Noise voltage: 1500Vpp, noise amplitude: 1μs, noise frequency: 25 to 60 Hz, with a noise simulator (2) Noise voltage : IEC801-4, 2 kV				
Withstand voltage	2830VAC rms/3 cycles across all inputs/LG and all outputs/FG (altitude 2000m (6557.38ft.))				
Insulation resistance	5MΩ or more by 500VDC insulation resistance tester across all inputs/LG and all outputs/FG				
Ground	Class 3 grounding. Connect to enclosure when grounding is impossible.				
Operating environment	No corrosive gas, low dust				
Cooling method	Natural cooling.				

REMARKS

*1 An “octave” refers to an increase or decrease in frequency by a factor of two. For example, the following are all octaves: 10 Hz to 20 Hz, 20 Hz to 40 Hz, 40 Hz to 20 Hz, and 20 Hz to 10 Hz.
Refer to “CHAPTER 2 DESIGN” for the installation environment and mounting instructions.

*2 JIS: Japan Industrial Standards

WARNING

Class 3 grounding should be used. The motion controller should not share a common ground with any other equipment. The ground terminal is located on the motion controller module terminal block. (See Section 1.5.2.)

CAUTION

The motion controller must be stored and operated under the conditions listed in the table of specifications above.
Disconnect the power cables from the motion controller if it is to remain unused for a long period of time.
Insert a controller or servo amplifier into the static-proof vinyl bag for storage.
Consult the system service or service station before storing equipment for a long period of time.

1.5 Specifications and Settings of Components

1.5.1 A173UHCPU/A172SHCPUN/A171SHCPUN

(1) Basic specifications of A173UHCPU, A172SHCPUN and A171SHCPUN

<table>
<tr><th colspan="4">Item</th><th colspan="2">A173UHCPU(-S1)</th><th>A172SHCPUN</th><th>A171SHCPUN</th></tr>
<tr><td rowspan="3">Motion</td><td colspan="3">No. of control axes</td><td colspan="2">32-axes</td><td>8-axes</td><td>4-axes</td></tr>
<tr><td rowspan="2">Computing frequency</td><td>SV13</td><td colspan="2">3.5 ms/1 to 20 axes
7.1 ms/21 to 32 axes</td><td rowspan="2">3.5 ms/1 to 8 axes</td><td rowspan="2">3.5 ms/1 to 4 axes</td></tr>
<tr><td>SV22</td><td colspan="2">3.5 ms/1 to 12 axes
7.1 ms/13 to 24 axes
14.2 ms/25 to 32 axes</td></tr>
<tr><td rowspan="10">PC</td><td colspan="2">Sequencer CPU</td><td colspan="2">Equivalent to A3UCPU</td><td>Equivalent to reinforced I/O memory of A2SHCPU</td><td>Equivalent to A2SHCPU</td></tr>
<tr><td rowspan="2">Processing speed (μs) (Sequence instruction)</td><td>Direct method</td><td colspan="2">—</td><td colspan="2">0.25 to 1.9μs/step</td></tr>
<tr><td>Refresh method</td><td colspan="2">0.15μs/step</td><td colspan="2">0.25μs/step</td></tr>
<tr><td colspan="2">No. of I/O points</td><td colspan="2">8192 points</td><td colspan="2">2048 points</td></tr>
<tr><td colspan="2">No. of real I/O points *1</td><td colspan="2">2048 points</td><td>1024 points</td><td>512 points</td></tr>
<tr><td colspan="2" rowspan="2">Memory capacity (built-in RAM)</td><td>Standard</td><td>192k bytes (Equivalent to A3NMCA-24)</td><td rowspan="2">192k bytes (Equivalent to A3NMCA-24)</td><td rowspan="2">64k bytes (Equivalent to A3NMCA-8)</td></tr>
<tr><td>-S1</td><td>768k bytes (Equivalent to A3AMCA-96)</td></tr>
<tr><td colspan="2">Program capacity (Main sequence)</td><td colspan="2">Max. 30k steps</td><td>Max. 30k steps</td><td>Max. 14k steps</td></tr>
<tr><td colspan="2">No. of file register (R)</td><td colspan="4">Max. 8192 registers</td></tr>
<tr><td colspan="2" rowspan="2">No. of extension file register block *2</td><td>Standard</td><td>Max. 10 blocks</td><td rowspan="2">Max. 10 blocks</td><td rowspan="2">Max. 2 blocks</td></tr>
<tr><td>-S1</td><td>Max. 46 blocks</td></tr>
<tr><td colspan="2">No. of sequencer extension base units</td><td colspan="4">Max. one</td></tr>
<tr><td rowspan="4">System configuration</td><td colspan="2">Pulser synchronous encoder interface unit</td><td colspan="2">A172SENC×4
(Corresponding to external signal input 32-axes)</td><td colspan="2">A172SENC×1
(Corresponding to external signal input 8-axes)</td></tr>
<tr><td colspan="2">No. of SSCNET I/F</td><td colspan="2">4CH.</td><td colspan="2">2CH.
SSCNET1..... For connection of servo amplifier
SSCNET2..... For personal computer link dedicated</td></tr>
<tr><td rowspan="2">Teaching unit (OS with teaching function)</td><td>A30TU-E</td><td colspan="4">○</td></tr>
<tr><td>A31TU-E</td><td colspan="4">○ (With dead-man switch)</td></tr>
<tr><td rowspan="5">Compatibility</td><td colspan="2">Sequence program, parameter</td><td colspan="2" rowspan="4">After starting A173UHCPU and reading a file, those created by A273UHCPU (32-axes) can be used as it is.</td><td colspan="2" rowspan="4">After starting A172SH/A171SH and reading a file, those created by A171SCPU can be used as it is.</td></tr>
<tr><td colspan="2">Servo program</td></tr>
<tr><td colspan="2">Mechanism program (SV22)</td></tr>
<tr><td colspan="2">Parameter</td></tr>
<tr><td colspan="2">System setting</td><td colspan="2">Must be set anew.</td><td colspan="2">By making sure of system setting screen after being started up by A172SH/A171SH and reading a file, changeover below is carried out:
A171SCPU → A172SH/A171SHCPUN
A171SENC → A172SENC
now the system is ready for operation.</td></tr>
<tr><td colspan="4">Outside dimensions</td><td colspan="4">130×113.3×93.6 (5.12×4.46×3.69) unit = mm (inch)</td></tr>
<tr><td colspan="4">Weight (kg (lb))</td><td colspan="4">0.85 (1.87)</td></tr>
</table>

*1 The real I/O points can be used within the range of one extension base.

*2 No. of extension file register blocks varies depending on the setting of program capacity, No. of file registers, and No. of comments.

(2) Functions and performance specifications of PCPU

The performance specifications and functions of the PCPU depend on the motion function OS model installed in the CPU module.

Refer to the programming manual of the motion functions installed in the CPU module.

(3) SCPU performance specifications and functions

(a) SCPU performance specifications

As the SCPU performance specifications differ according to the operating system used, refer to the appropriate OS Programming Manual for details.

Table 1.2 Table of SCPU Performance Specifications

Item			A173UHCPU(-S1)		A172SHCPUN	A171SHCPUN
Control method			Stored programs repeated operation			
I/O control method			Refresh method		Refresh method/direct method (selectable)	
Programming language			Sequence control dedicated language (Relay symbol language, logic symbol language, MELSAP-II (SFC))			
Number of instructions		Sequence instructions	22		26	
		Basic instructions	252		131	
		Special instructions	204		106	
		Motion dedicated instructions	4		4	
Processing speed (μs) (sequence instructions)		Direct method	—		0.25 to 1.9 μs/step	
		Refresh method	0.15 μs/step		0.25 μs/step	
No. of I/O points			8192 points (X/Y0 to 1FF)		2048 points (X/Y0 to X/Y7FF)	
No. of real I/O points *5			2048 points (X/Y0 to 7FF)		1024 points (X/Y0 to X/Y3FF)	512 points (X/Y0 to X/Y1FF)
Watchdog timer (WDT)			200 ms fixed		10 to 2000 ms	
Memory capacity (internal RAM)			Standard	192k bytes (Equivalent to A3NMCA-24)	192k bytes	64k bytes
			-S1	768k bytes (Equivalent to A3AMCA-96)		
Program capacity		Main sequence program	Max. 30 k steps			Max. 14k steps
		Sub-sequence program	Max. 30k steps		None	None
		Micro computer program	None		Max. 58k bytes	Max. 26k bytes
Device	No. of internal relays (M) *1		7144 points (M0 to M999, M2048 to M8191)		1000 points (M0 to M999)	
	No. of latch relays (L)		1048 points (L1000 to L2047)			
	No. of step relays (S)		0 point (none at initial status)			
	No. of link relays (B)		8192 points (B0 to B1FFF)		1024 points (B0 to B3FF)	
	Timers (T)	Points	256 points			
		Specifications	*3			
			Time setting	Device		
			100 ms timer	0.1 to 3276.7s	T0 to T199	
			10 ms timer	0.01 to 327.67s	T200 to T255	
			100ms retentive timer	0.1 to 3276.7s	No initial value	
			Set with parameters			
	Counters (C)	Points	256 points			
		Specifications	*4			
			Setting range	Device		
			Normal counter	1 to 32767	C0 to C255	
			Interrupt program counter	1 to 32767	C224 to C255 (No initial value)	
			Set with parameters			
	No. of data registers (D) *1		8192 points (D0 to D8191)		1024 points (D0 to D1024)	
	No. of link registers (W)		8192 points (W0 to W1FFF)		1024 points (W0 to W3FF)	
	No. of annunciators (F)		2048 points (F0 to F2047)		256 points (F0 to F255)	
	No. of file registers (R)		Max. 8192 points (R0 to R8191) (set with parameters)			
	No. of accumulators (A)		2 points (A0, A1)			
	No. of index registers (V, Z)		14 points (V, V_1 to V_6, Z, Z_1 to Z_6)		2 points (V, Z)	
	No. of pointers (P)		256 points (P0 to P255)			
	No. of interrupt pointers (I)		32 points (I0 to I31)			
	No. of special-function relays(M)		256 points (M9000 to M9255)			
	No. of special-function registers (D)		256 points (D9000 to D9255)			

Table 4.1 Table of SCPU Performance Specifications (Continued)

Item	A173UHCPU (-S1)		A172SHCPUN	A171SHCPUN
No. of extension file register block	Standard	Max. 10 blocks (set by memory capacity)	Max. 10 blocks*6 (set by memory capacity)	Max. 3 blocks*6 (set by memory capacity)
	-S1	Max. 46 blocks (set by memory capacity)		
No. of comments	Max. 4032 points (64k bytes), 1 point = 16 bytes (set in 64-point unit)			
No. of extension comments *2	Max. 3968 points (63k bytes), 1 point = 16 bytes (set in 64-point unit)			
Self-diagnosis function	Watchdog error monitoring, memory/CPU/input output/battery, etc. error detection			
Operating mode on error	Select stop/continue			
Output mode selection when switching from STOP to RUN	Select re-output operation status before STOP (default) or output after operation execution.			
Clock function	Year, month, day, hour, minute, day of the week (leap year automatic distinction)			

*1 Range of positioning dedicated devices differs depending on the OS. Refer to the Programming Manual of each OS.
When shared between M, L and S, the total number of devices points is 8192 for the A173UHCPU or 2048 for the A172SHCPUN/A171SHCPUN.

*2 Extension comments are not stored into the internal memory of the CPU.

*3 For the A173UHCPU, set the times of the extension timers (T256 to T2047) using the word devices (D, W, R).

*4 For the A173UHCPU, set the count values of the extension counters (C256 to C1023) using the word devices (D, W, R).

*5 The real I/O points can be used within the range of one extension base.

*6 SW0GHP-UTLP-FN1 is necessary for using A6GPP and A6PHP.

(b) SCPU functions

Refer to the A2SHCPU user's manual for details of the SCPU functions of A171SHCPUN/A172SHCPUN and A3UCPU user's manual for details of the SCPU functions of A173UHCPU.

Table 1.3 Table of SCPU Functions

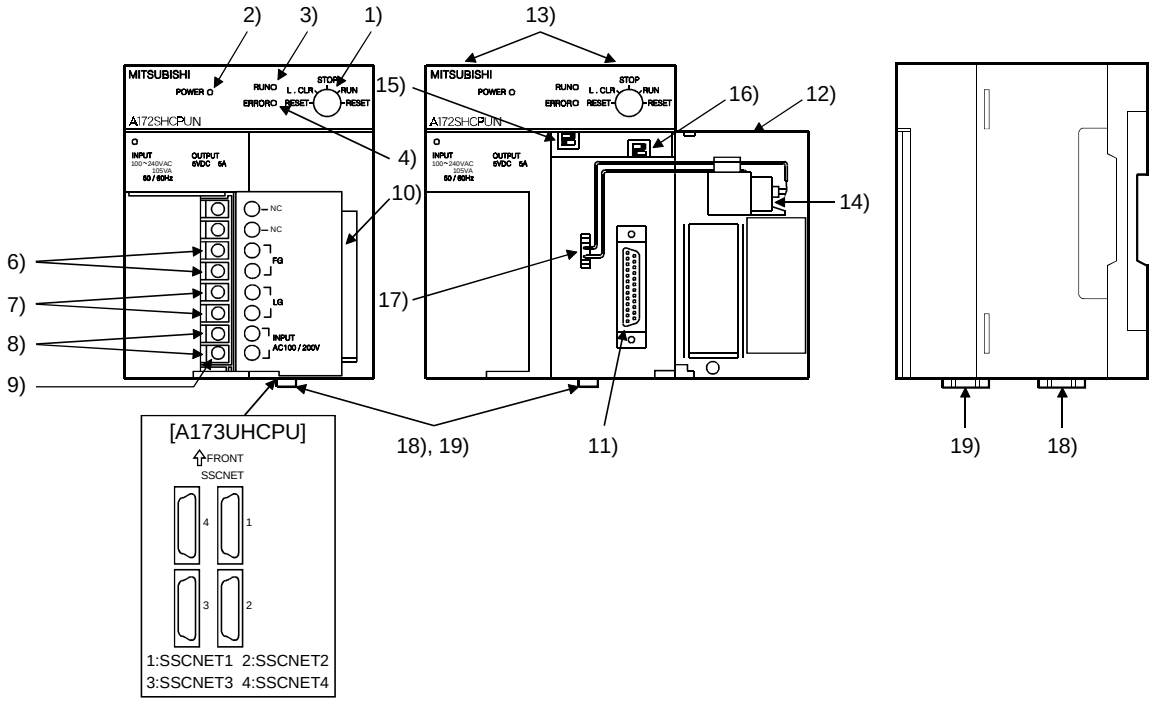
Function	Description
Constant scan	• Sets a constant time for one scan of a sequence program which is independent of the sequence program scan. • Set the constant scan time between 10 ms and 2000 ms.
Latch (hold on power interruption)	• The contents of devices set as latch devices are retained when a reset or a power interruption over 20 ms occurs if the power is turned off. • Devices L, B, T, C, D, W can be set as latch devices.
Remote RUN/STOP	• Conducts remote RUN/STOP sequence control from external inputs or peripheral devices when the RUN/STOP switch is set to RUN.

PAUSE	• Stops the operation and holds the output (Y) ON/OFF status.
	• The PAUSE status can be set by two method:
	  • With the remote PAUSE contacts
	  • From a peripheral device

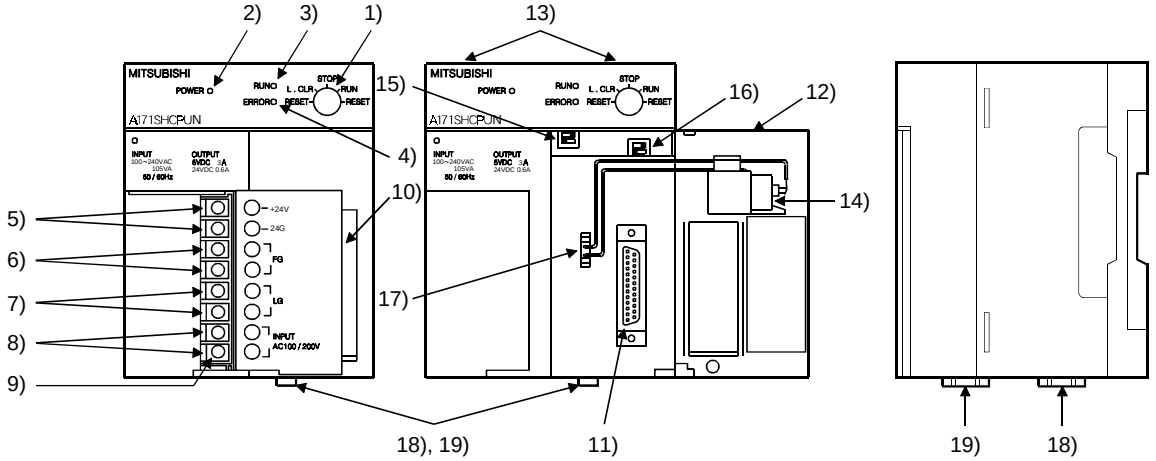
Status latch	• The contents of all devices are written to the CPU module status latch area when the status latch conditions are met. • The contents of the devices stored in the status latch area can be monitored from a peripheral device.
Sampling trace	• The operating status of the designated device is sampled at the set interval, and the results are stored in the CPU module sampling trace area. • Data stored in the sampling trace area can be monitored from a peripheral device.
Off-line switch	• Separates the devices (Y, M, L, S, F, B) used by the OUT instruction from the sequence program operations.
Error indicator order or priority	• Sets order in which the indicators light and go out when an error occurs.
Clock	• Executes the CPU module internal clock operations. • Clock data is: year, month, day, hour, minute, second, day of week. • The clock data can be read to D9025 to D9028.

(4) Names of A173UHCPU/A172SHCPUN/A171SHCPUN Parts

A173UHCPU/A172SHCPUN



A171SHCPUN

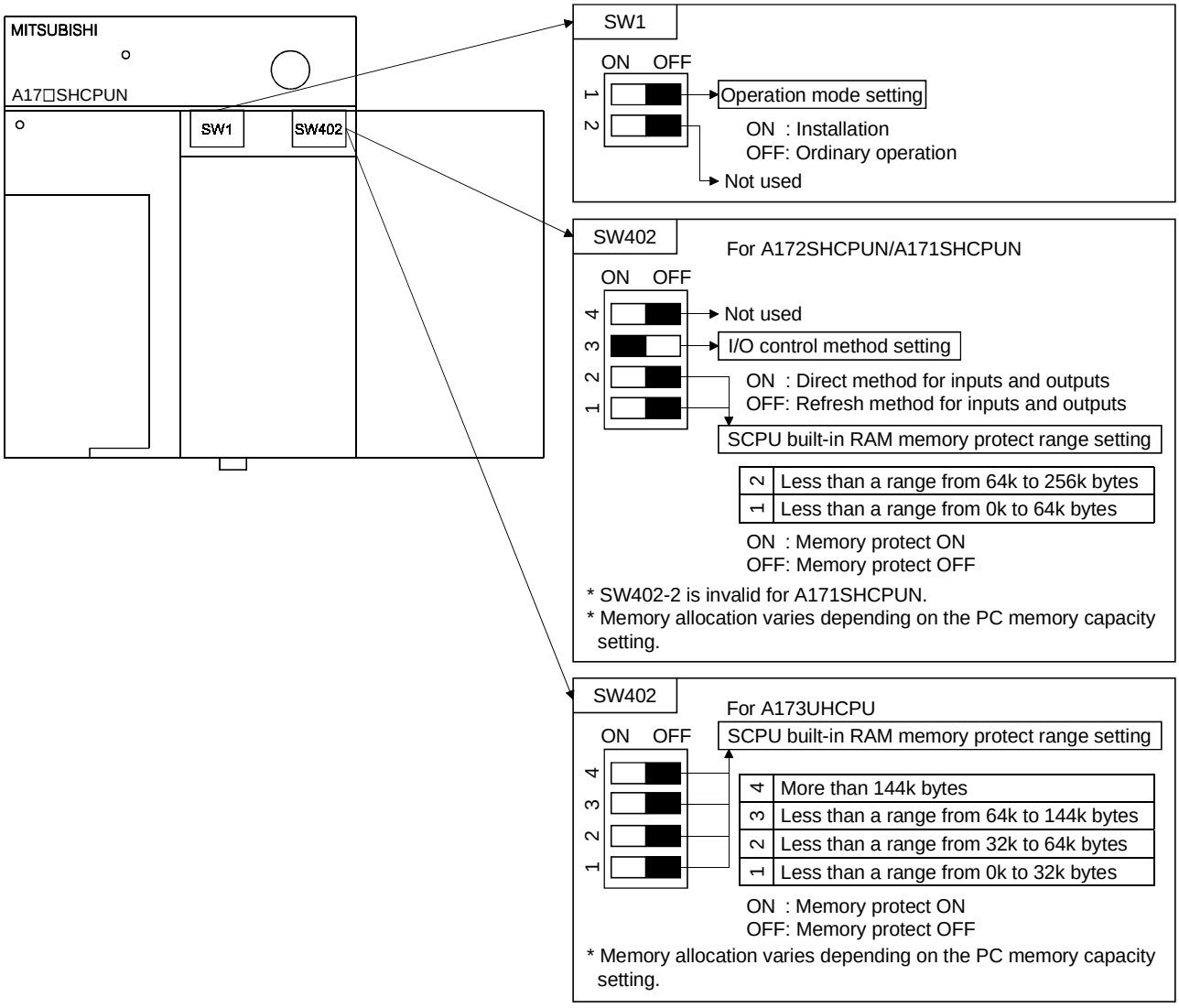


No.	Name	Application
1)	RUN/STOP key switch	• RUN/STOP: Starts or stops operation of a sequence program. • RESET: Resets the hardware. Applies a reset after an operation error occurs and initializes the operations. • LATCH CLEAR (L. CLR): Clears the latch area data set with the parameters (to OFF or 0). (LATCH CLEAR also clears data outside the latch area.)
2)	POWER indicator	• Display indicator for 5 VDC power supply.

No.	Name	Applications
3)	RUN indicator	• Lit: Sequence program operating with RUN/STOP key switch set to RUN. (The indicator remains lit if an operation error occurs in the sequence program (Refer to section 5.4.1 (10)).) • Not lit: The RUN indicator is not lit in the following cases: • No 100/200 VAC power supplied to the CPU module. • RUN/STOP key switch is set to STOP. • A remote STOP is applied. • A remote PAUSE is applied. • Flashing: The RUN indicator flashes in the following cases: • Self-diagnosis function detected an error which stops sequence program operation. • A latch clear operation is conducted.
4)	ERROR indicator	• Lit: Self-diagnosis function detected an error. (However, the indicator does not light if it is set not to light for the error detected in the order of priority settings.) • Not lit: Normal, or error detected by CHK instruction. • Flashing: Sequence program annunciator (F) is on.
5)	24 VDC, 24 GDC terminals	• Internally supplies output modules which require 24 VDC (supplied through external wiring). (A171SHCPUN only)
6)	FG terminal	• A grounding terminal connected with the shielding pattern on the printed circuit board.
7)	LG terminal	• Ground for power supply filter, with 1/2 the electrical potential of the input voltage.
8)	Power supply input terminals	• Connect the 100 VAC or 200 VAC power supply to the power supply input terminals.
9)	Terminal screws	• M3.5 × 7
10)	Terminal cover	• A cover to protect the terminal block.
11)	RS-422 connector	• Connector to read, write, monitor, or test main programs with a peripheral device. • Covered by a cover when not connected to a peripheral device.
12)	Covers	• Open the protective cover for the printed circuit board, RS-422 connector, or battery to carry out the following operations: • Set DIP switches. • Connect the battery connectors. • Replace the battery.
13)	Module fixing screws	• Screws to fix the module to the base unit.
14)	Battery	• Back-up battery for programs, devices in the latch range, and file registers. (See Section 1.5.7 for the battery mounting procedure.)
15)	DIP switch 1	• Installation switch This switch is used to change the installed CPU module operating system with a peripheral device. (See Section 1.5.1 (5) for details about the switch settings.) ON : Turn ON to install an operating system. OFF : Turn OFF to enable CPU operation when OS installation is complete.
16)	DIP switch 402	• This switch selects the I/O control method and enables or disables memory protection. (See Section 1.5.1 (5) for details about the switch settings.)
17)	Battery connector	• A connector for connecting the battery unit
18)	Motion network connector (SSCNET1 to 2 (A172SHCPUN/ A171SHCPUN) SSCNET1 to 4 (A173UHCPU))	• Connectors to HR-H-BN/MR-J2S-B/MR-J2-B.

No.	Name	Applications
19)	Personal computer link SSC connector (SSCNET2 (A172SHCPUN/ A171SHCPUN) SSCNET4 (A173UHCPU))	• A connector for linking a personal computer and personal computer link SSC. When using the A172SHCPUN/A171SHCPUN, connect the servo amplifier or personal computer to SSCNET2, or when using the A173UHCPU, connect it to SSCNET4.

(5) Switch settings



⚠ CAUTION

⚠ Switch SW1-2 is for use by the manufacturer only.
Leave this switch set OFF.
Operation cannot be guaranteed if this switch is set to ON.

POINTS

(1) Turn off the power supply before setting the install switch.
(2) After using this switch, check the switch status before turning on the power supply.
(3) The switch settings shipped from the factory are as shown above. The switch settings are indicated by a mark (■).
(4) Whenever the switch settings are changed, be sure to reset the key of the CPU once or turn on the power again.
(5) Turn off the power before setting the I/O control changeover switch.
(6) After using this switch, check the switch status before turning on the power supply.
(7) A BIN value corresponding to the selected I/O control method is input in special-function register D9014 and can be monitored from a peripheral device. (A172SHCPUN/A171SHCPUN)
• Direct method for inputs and outputs..... 0
• Refresh method for inputs and outputs 3
(8) When executing the sampling trace and/or the status latch, do not protect the memory. If the memory is protected, the result of execution cannot be stored in the memory.

(6) Functions and performance specificotions of
A173UHCPU/A172SHCPUN/A171SHCPUN internal power supply.

Table 1.4 Internal Power Supply Specifications

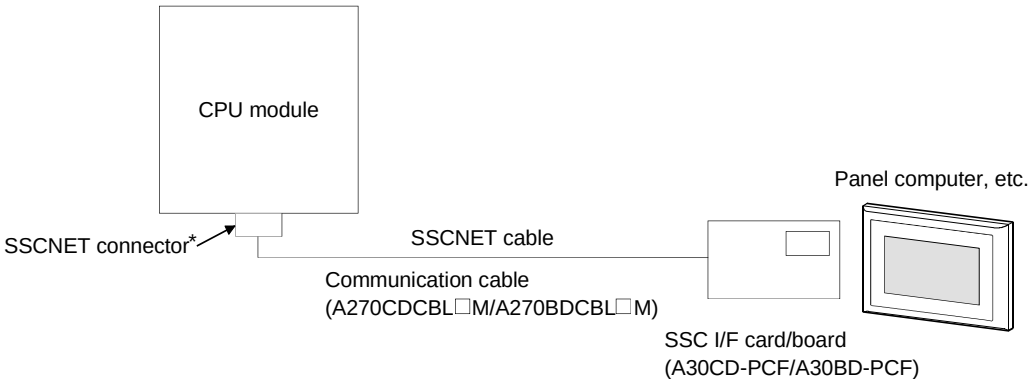
Item		Specifications	
Model name		A173UHCPU/A172SHCPUN	A171SHCPUN
Input power supply		100 to 240 VAC $^{+10\%}_{-15\%}$ (85 to 264 VAC)	
Input frequency		50/60 Hz ±5 %	
Max. apparent input power		105VA	
Rush current		20A 8ms max.	
Rated output current	5VDC	5A	3A
	24VDC ±10%	—	0.6A
Overcurrent protection *1	5VDC	5.5 A min.	3.3 A min.
	24VDC	—	0.66 A min.
Overvoltage protection *2	5VDC	5.5 to 6.5 V	
	24VDC	—	
Efficiency		65% min.	
Power indicator		LED indicator (Lit at 5VDC output)	
Terminal screw size		M3.5 × 7	
Applicable power cable size		0.75 to 2mm^2	
Applicable solderless terminal		RAV 1.25-3.5 RAV 2-3.5	
Applicable tightening torque		59 to 88 N·cm	
Permissible instantaneous power interruption time		20ms max.	

POINTS

*1: Overcurrent protection
When current in excess of the specifications flows through the 5 VDC or 24 VDC circuits, the overcurrent protection device breaks the circuit and stops the system.
A drop in voltage will extinguish or dim the CPU module indicator "POWER" display.
After overcurrent protection operates, start up the system after eliminating the cause, such as insufficient current capacity or short circuit.
The system initial start commences when the current returns to the normal level.

*2: Overvoltage protection
When an overvoltage of 5.5 V to 6.5 V is applied to a 5 VDC circuit, the overvoltage protection device breaks the circuit and stops the system.
The CPU module indicator goes out.
To restart the system, switch the input power supply off, and then turn it back on. The system initial start commences.
If the system does not start up and the indicator "POWER" display remains off, the CPU module must be changed.

(7) Information control processing making use of personal computer
By connecting a personal computer to the SSCNET, you can add to the motion system the digital oscilloscope functions used for monitoring the equipment status and for checking the operation, tuning and timing of the equipment and the user-developed software functions (e.g. machining/assembling recipe function and data supervising collection function).
Refer to the manual of the corresponding software package.



* : Connect to SSCNET2 for the A171SHCPUN/A172SHCPUN or to SSCNET4 for the A173UHCPU.

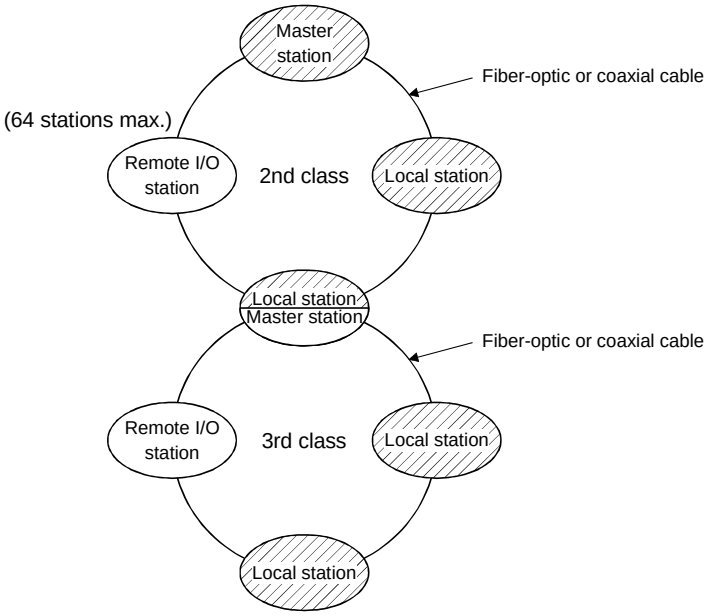
(8) MELSECNET(II)/10 system
The motion system can use the MELSECNET(II)/10 system. The usable MELSECNET system depends on the CPU module. (See the following table.)
Load the module given in the following table into the PC slot to configure a data link system.

MELSECNET System	A172SHCPUN/A171SHCPUN	A173UHCPU	Module
MELSECNET (II)	Usable(MELSECNET mode or MELSECNET II mixed mode only)	Usable	A1SJ71AP21/R21
MELSECNET/10	Usable (local station only)	Usable	A1SJ71LP21/BR11

In the MELSECNET(II) data link system, the motion CPU module can be used as the master or local station in each layer. When it is used as the master station in layer 3 (local station in layer 2), up to two data link modules (A1SJAP21/R21) may be used.
In the MELSECNET/10 network system, the motion CPU module can be used as the control or normal station. Up to four network modules (A1SJ71LP21/BR11) may be loaded to achieve separate network configurations.

Refer to the following manuals when using the MELSECNET(II) data link system and MELSECNET/10 network system.
- MELSECNET(II), MELSECNET/B data link system reference manual
- MELSECNET/10 data link system reference manual (Inter-PC network manual)

(a) MELSECNET(II)

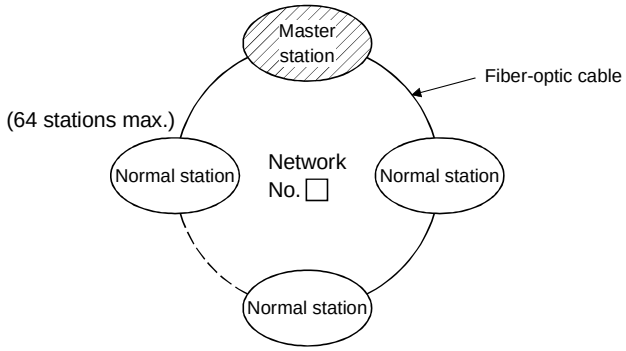


POINTS

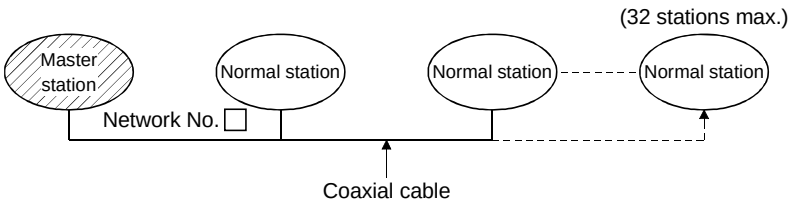
As the instruction for other station access in the MELSECNET(II) data link system, note that the system is not compatible with other station access via the motion controller, e.g. access to the motion controller from the peripheral device connected to the sequencer CPU, access to the sequencer CPU from the peripheral device connected to the motion controller, and access to the motion controller from the personal computer on the network.

(b) MELSECNET/10

1) Optical loop network



2) Coaxial bus network

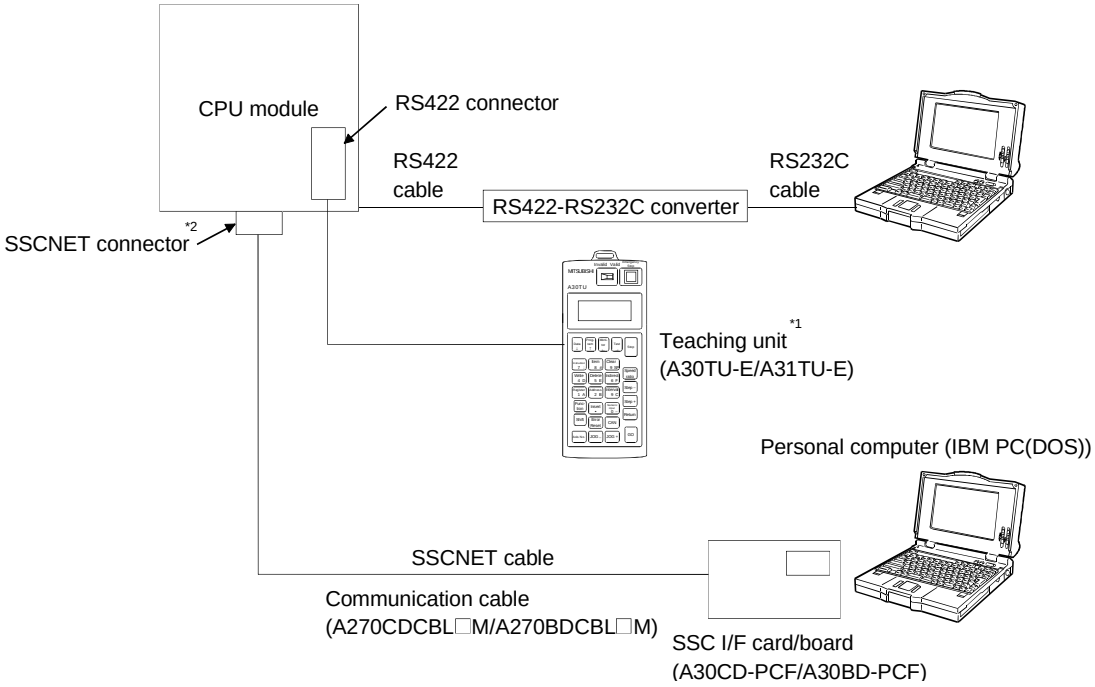


(9) Connection of peripheral device

This section explains how to connect the peripheral device used to install the motion functions (motion OS) to the CPU module, create motion programs, create sequence programs, and perform JOG operation and teaching.

As the peripheral device, use the IBM PC available on the market or the teaching unit (A30TU-E, A31TU-E). It may be connected by making connection either from the RS422 connector at the CPU module front or via the SSCNET. Connection via the SSCNET enables faster communication than connection via RS422 and further allows use of the digital oscilloscope functions and monitoring and operating software programs.

The positioning software package used on the peripheral device (personal computer) depends on the motion functions used. For details, refer to the programming manual of the motion functions used.



*1: The A31TU-E must be connected with the external circuit. For details, refer to Section 1.5.5 (2).

*2: Use SSCNET2 for A171SHCPUN/A172SHCPUN or SSCNET4 for A173UHCPU.

1.5.2 Extension Base Power Supply Module

(1) Power supply module specifications

Table 1.5 Power Supply Module Specifications

Item		Specifications	
		A1S61PN	A1S62PN
Mounting position in base		Power supply module mounting slot	
Input power supply		200 to 240 VAC $^{+10\%}_{-15\%}$ (85 to 264 VAC)	
Input frequency		50/60 Hz ±5%	
Max. apparent input power		105VA	
Rush current		20A 8ms max.	
Rated output current	5VDC	5A	3A
	24VDC ±10%	—	0.6A
Overcurrent protection *1	5VDC	5.5 A min.	3.3 A min.
	24VDC	—	0.66 A min.
Overvoltage protection *2	5VDC	5.5 to 6.5 V	
	24VDC	—	
Efficiency		65% min.	
Withstand voltage		2,830VAC rms/3 cycles across all inputs/LG and all outputs/FG (altitude 2,000m (6557.38 ft))	
Insulation resistance		5MΩ or more by 500VDC insulation resistance tester across all inputs/LG and all outputs/FG	
Noise immunity		(1) By noise simulator of 1,500Vp-p noise voltage, 1μs noise width and 25 to 60Hz noise frequency (2) Noise voltage IEC801-4, 2kV	
Power indicator		LED indicator	
Terminal screw size		M3.5×7	
Applicable power cable size		0.75 to 2mm^2	
Applicable solderless terminal		RAV 1.25-3.5 RAV 2-3.5	
Applicable tightening torque		59 to 88 N·cm	
External dimensions mm (inch)		130×54.5×93.6 (5.12×2.15×3.69)	
Weight kg (lb)		0.6 (1.32)	
Permissible instantaneous power interruption time		20ms max.	

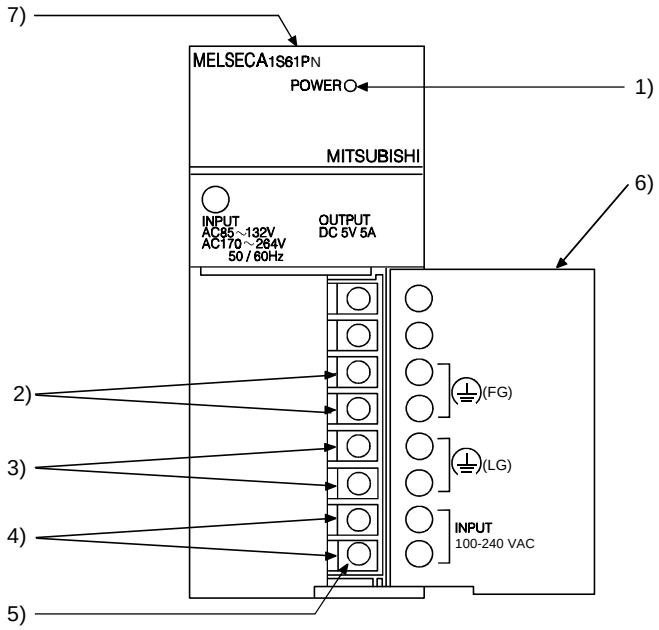
POINT

*1: Overcurrent protection
When current in excess of the specifications flows through the 5 VDC or 24 VDC circuits, the overcurrent protection device breaks the circuit and stops the system.
A drop in voltage will extinguish or dim the power supply module indicator “POWER” display.
After overcurrent protection operates, start up the system after eliminating the cause, such as insufficient current capacity or short circuit.
The system initial start commences when the current returns to the normal level.

*2: Overvoltage protection
When an overvoltage of 5.5 V to 6.5 V is applied to a 5 VDC circuit, the overvoltage protection device breaks the circuit and stops the system.
The power supply module indicator goes out.
To restart the system, switch the input power supply off, and then turn it back on. The system initial start commences.
If the system does not start up and the indicator “POWER” display remains off, the power supply module must be changed.

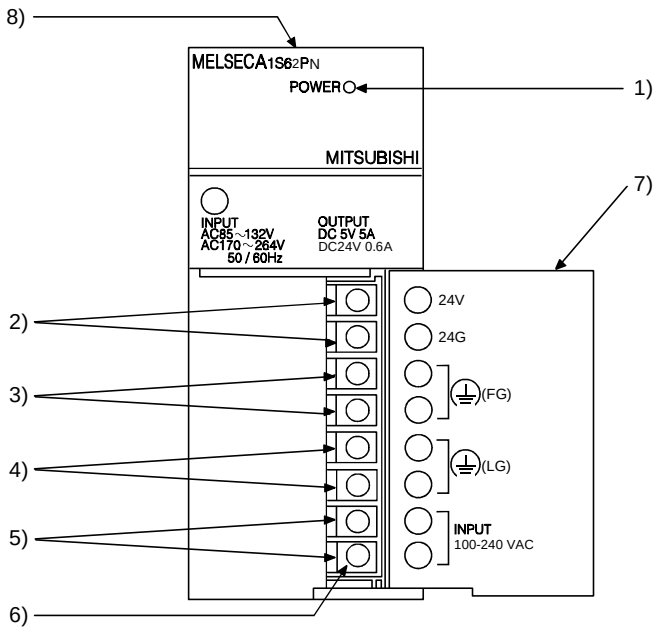
(2) Names of parts

(a) A1S61PN power supply module names of parts



No.	Name	Application
1)	POWER indicator	Display indicator for 5 VDC power supply.
2)	FG terminal	A grounding terminal connected with the shielding pattern on the printed circuit board.
3)	LG terminal	Ground for power supply filter, with 1/2 the electrical potential of the input voltage.
4)	Power supply input terminals	Connect the 100 VAC or 200 VAC power supply to the power supply input terminals.
5)	Terminal screws	M 3.5×7
6)	Terminal cover	A cover to protect the terminal block.
7)	Module fixing screws	Screws to fix the module to the base unit.

(b) A1S62PN power supply module names of parts



No.	Name	Application
1)	POWER indicator	Display indicator for 5 VDC power supply.
2)	24VDC, 24GDC terminals	Supplies output modules which require 24 VDC internally (supplied through external wiring).
3)	FG terminal	A grounding terminal connected with the shielding pattern on the printed circuit board.
4)	LG terminal	Ground for power supply filter, with 1/2 the electrical potential of the input voltage.
5)	Power supply input terminals	Connect the 100 VAC or 200 VAC power supply to the power supply input terminals.
6)	Terminal screws	M 3.5×7
7)	Terminal cover	A cover to protect the terminal block.
8)	Module fixing screws	Screws to fix the module to the base unit.

1.5.3 Base Units and Extension Cables

(1) Performance specifications

(a) Base unit specifications

1) Main base unit specifications

Table 1.6 Table of Main Base Unit Specifications

Item \ Model Name	A172B	A175B	A178B	A178B -S1	A178B -S2	A178B -S3
No. of motion slots	1	1	1	2	4	8
No. of sequencer slots	1	4	7	6	4	0
Extension connections	OK					
Mounting hole size	φ6 dia. slot (for M5 screw)					
External dimensions mm(inch)	220×130×28 (8.67×5.12×1.1)	325×130×28 (12.8×5.12×1.1)	430×130×28 (10.93×5.12×1.1)			
Weight kg (lb)	0.51 (1.12)	0.75 (1.66)	0.97 (2.14)			
Accessories	Mounting screws M5×25 4 pcs					

POINT

Configure a system by choosing the motion modules and MELSEC-A series I/O modules so that the sum of 5VDC consumed currents of the motion modules, MELSEC-A series I/O modules, synchronous encoders and manual pulse generators connected to the main base unit is within 5 (A) for the A172SHCPUN or 3 (A) for the A171SHCPUN.

2) Extension base unit specifications

Table 1.7 Table of Extension Base Unit Specifications

Item \ Model Name	A1S65B	A1S68B	A168B
Max. I/O modules mountable	5 modules	8 modules	
Power supply module	Must be mounted		
Connectivity of second/ subsequent stage of extension base unit	Second/subsequent stage unconnectable		Only GOT connectable
Mounting hole size	φ6 dia. slot (for M5 screw)		
External dimensions mm(inch)	315×130×28 (12.4×5.12×1.1)	420×130×28 (16.55×5.12×1.1)	420×130×28 (16.55×5.12×1.1)
Weight kg (lb)	0.71 (1.56)	0.95 (2.09)	0.95 (2.09)
Accessories	Mounting screws M5×25 4 pcs		

(b) Specifications of extension cable

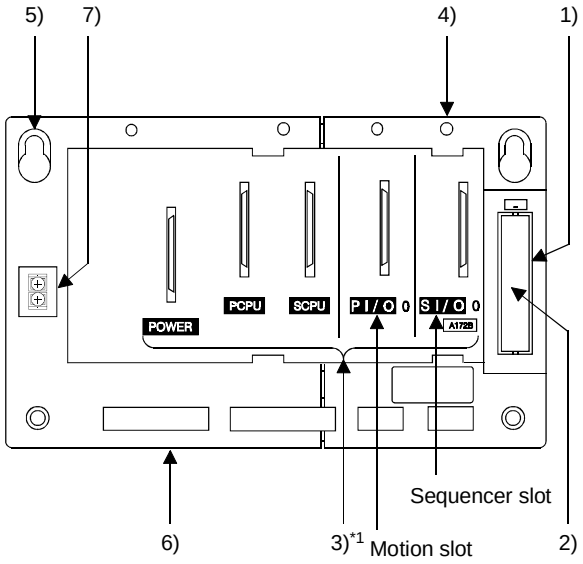
The specifications for extension cables which can be used with the motion system are shown in Table 1.8.

Table 1.8 Table of Extension Cable Specifications

Item \ Model Name	A1SC01B	A1SC03B	A1SC12B	A1SC30B
Cable length m (inch)	0.055 (2.17)	0.33 (12.99)	1.2 (47.24)	3.0 (118.11)
Resistance of 5 VDC supply line (Ω at 55°C)	0.22	0.021	0.055	0.121
Application	Connecting main base unit to extension base unit			
Weight kg (lb)	0.025 (0.06)	0.10 (0.22)	0.20 (0.44)	0.4 (0.48)

(2) Names and settings of parts

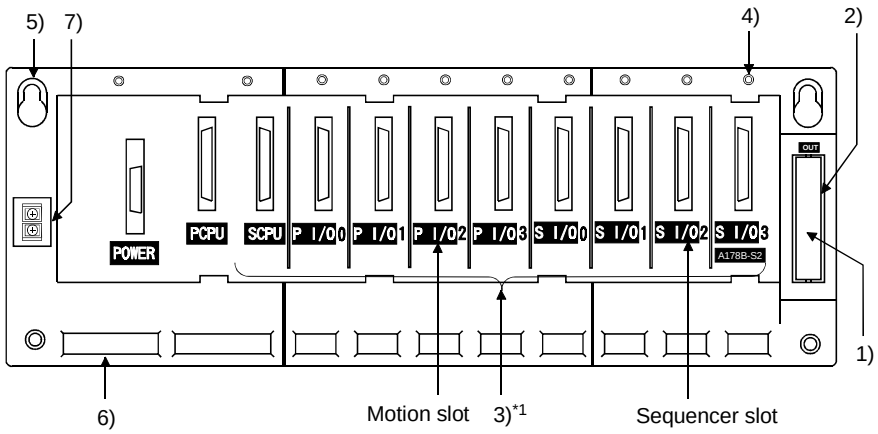
(a) Main base unit (A172B, A175B, A178B)



No.	Name	Application
1)	Extension cable connector	Connects to the signal communications connector on the extension base unit with the extension cable.
2)	Base cover	A cover for protecting the extension cable connector. When connecting to an extension base unit, cut out the area surrounded by the groove under the word “OUT” on the base cover with side cutters, or some other tool.
3)	Module connector	Connectors to mount the CPU module, I/O modules, and special-function modules. Install the supplied connector cover or blank cover (A1SG60) to prevent dust penetrating empty connector spaces. P I/0 : Motion slot For A172SENC, A1SY42 or MELSEC-A1S series I/O module A1SI61 S I/0 : Sequencer slot For MELSEC-A1S series module
4)	Unit fixing screw	Screws to fix the unit to the base. Screw size M4×12.
5)	Base mounting hole	Slots for mounting the base unit onto the control board panel (for M5 screws)
6)	DIN rail hooks	Hooks to attach to the DIN rail. A172B..... 1 A175B, A178B..... 2
7)	Emergency stop terminal	Terminal block to apply servomotor emergency stop.

⚠ CAUTION
⚠ *1 : Install the supplied blind cap or blank cover (A1SG60) to prevent dust penetrating the empty connector spaces. Failure to do so can cause malfunctioning.

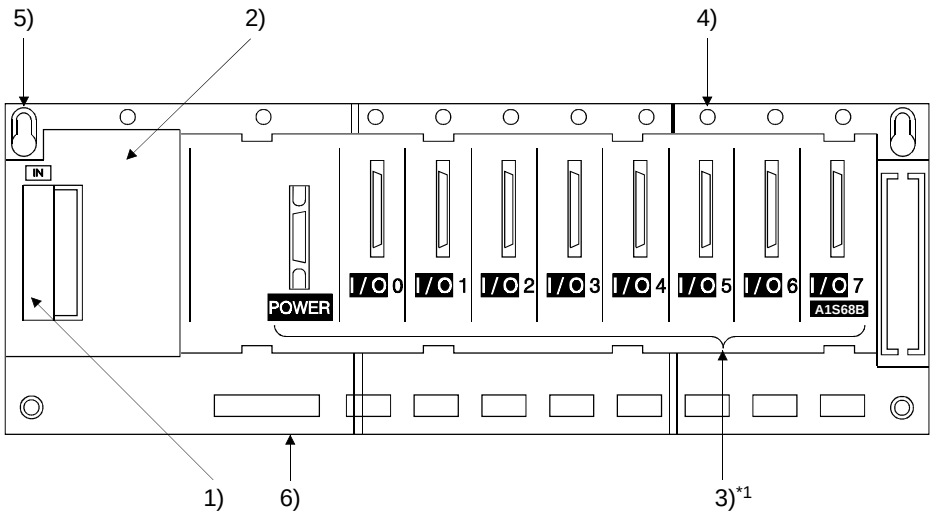
(b) Main base unit (A178B-S1/S2/S3)



No.	Name	Application
1)	Extension cable connector	Connects to the signal communications connector on the extension base unit with the extension cable.
2)	Base cover	A cover for protecting the extension cable connector. When connecting to an extension base unit, cut out the area surrounded by the groove under the word “OUT” on the base cover with side cutters, or some other tool.
3)	Module connector	Connectors to mount the CPU module, I/O modules, and special-function modules. Install the supplied connector cover or blank cover (A1SG60) to prevent dust penetrating empty connector spaces. P I/0 : Motion slot For A172SENC, A1SY42 or MELSEC-A1S series I/O module A1SI61 S I/0 : Sequencer slot For MELSEC-A1S series module
4)	Unit fixing screw	Screws to fix the unit to the base. Screw size M4×12.
5)	Base mounting hole	Slots for mounting the base unit onto the control board panel (for M5 screws)
6)	DIN rail hooks	Hooks to attach to the DIN rail. A178B-S1/S2/S3..... 2
7)	Emergency stop terminal	Terminal block to apply servomotor emergency stop.

⚠ CAUTION
⚠ *1 : Install the supplied blind cap or blank cover (A1SG60) to prevent dust penetrating the empty connector spaces. Failure to do so can cause malfunctioning.

(c) Extension base unit (A1S65B, A1S68B)

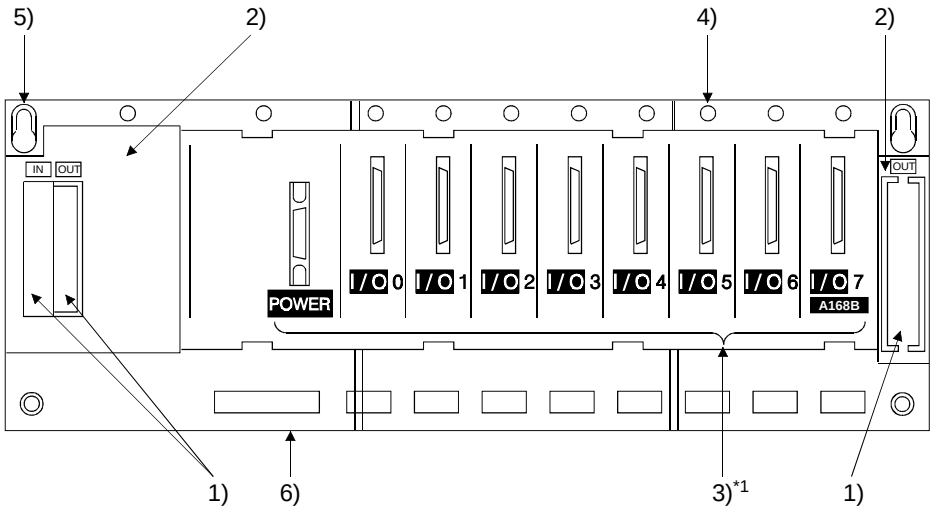


No.	Name	Application
1)	Extension cable connector	Connects to the signal communications connector on the main base unit with the extension cable. Remove the connector cover before connecting the extension cable.
2)	Base cover	A cover for protecting the extension cable connector.
3)	Module connector	Connectors to mount the power supply module, I/O modules, and special-function modules. Install the supplied connector cover or blank cover (A1SG60) to prevent dust penetrating empty connector spaces.
4)	Unit fixing screw	Screws to fix the unit to the base. Screw size M4×12.
5)	Base mounting hole	Slots for mounting the base unit onto the control board panel (for M5 screws)
6)	DIN rail hooks	Hooks to attach to the DIN rail. A1S65B, A1S68B 2

CAUTION

*1 : Install the supplied blind cap or blank cover (A1SG60) to prevent dust penetrating the empty connector spaces. Failure to do so can cause malfunctioning.

(d) Extension base unit (A168B)



No.	Name	Application
1)	Extension cable connector	Connects to the signal communications connector on the main base unit or bus coupling type GOT with the extension cable. Take off the supplied connector cover before connecting the extension cable.
2)	Base cover	A cover for protecting the extension cable connector. When connecting to bus coupling type GOT, cut out the area surrounded by the groove under the word “OUT” on the base cover with side cutters, or other appropriate tool.
3)	Module connector	Connectors to mount the Power module, I/O module, and special-function modules. Install the supplied connector cover or blank cover (A1SG60) to prevent dust penetrating empty connector spaces.
4)	Unit fixing screw	Screws to fix the unit to the base. Screw size M4×12.
5)	Base mounting hole	Slots for mounting the base unit onto the control board panel (for M5 screws).
6)	DIN rail hooks	Hooks to attach to the DIN rail. A168B.....2

⚠ CAUTION
⚠ *1 : Install the supplied blind cap or blank cover (A1SG60) to prevent dust penetrating the empty connector spaces. Failure to do so may cause malfunctioning.

(3) Selection of base units and extension cables

(a) Selection of main base unit

Choose the main base unit according to the number of pulse generator/synchronous encoder interface modules (A172SENC) and limit output modules (A1SY42) fitted to the main base (number of motion slots) and the number of sequencer I/O slots (number of sequence slots).

Selection of Main Base

Main Base Model	No. of Motion Slots (No. of A172SENCs and A1SY42s)	No. of Sequence Slots
A172B	1	1
A175B	1	4
A178B	1	7
A178B-S1	2	6
A178B-S2	4	4
A178B-S3	8	0

(b) Selection of sequence extension base unit and extension cable

Choose the sequence extension base according to the number of MELSEC-A series I/O modules fitted to the sequence extension base unit.

Selection of sequence Extension Base Unit

Extension Base Unit Model	MELSEC-A Series I/O Modules
A1S65B	For extension power supply + 5 slots, applicable to system with up to one extension base.
A1S68B	For extension power supply + 8 slots, applicable to system with up to one extension base.
A168B	For extension power supply + 8 slots, applicable to system where up to one extension base and GOT are bus-connected.

Choose the extension cable according to the distance between the main base unit and sequence extension base unit and the type of the sequence extension base unit. Note that the overall distance should be within 3m (9.84ft.).

Selection of Extension Cable

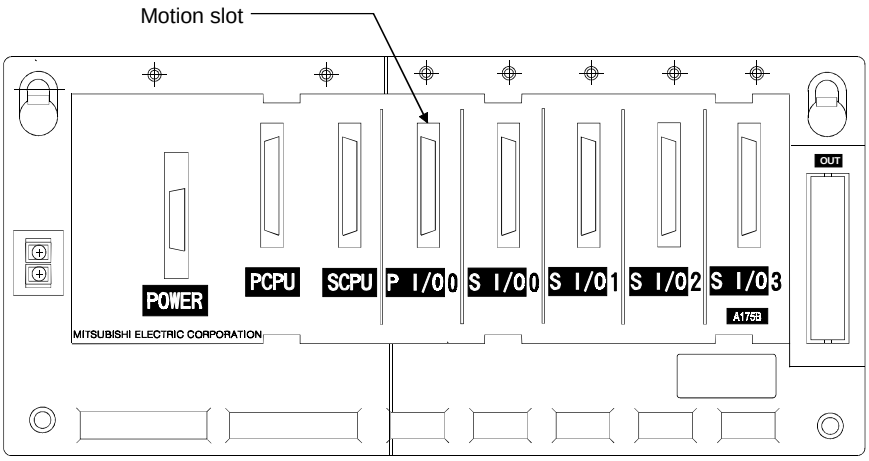
Extension Cable Model	Length mm (inch)	Type of Sequence Extension Base Unit
A1SC01B	55 mm (2.17 inch), flat cable for horizontal extension	For A1S6□B/A168B
A1SC03B	330 mm (13 inch)	
A1SC07B	700 mm (27.58 inch)	
A1SC12B	1200 mm (47.28 inch)	
A1SC30B	3000 mm (118.2 inch)	
A1SC60B	6000 mm (236.4 inch)	
A1SC05NB	450 mm (17.73 inch)	For A6□B
A1SC07NB	700 mm (27.58 inch)	
A1SC30NB	3000 mm (118.2 inch)	
A1SC50NB	5000 mm (196.9 inch)	

POINT

Choose the motion modules and MELSEC-A series I/O modules so that the sum of 5VDC consumed currents of the CPU module, motion modules, MELSEC-A series I/O modules, synchronous encoders and manual pulse generators connected to the main base unit is within 5 (A) for the A173UHCPU/A172SHCPUN or 3 (A) for the A171SHCPUN.

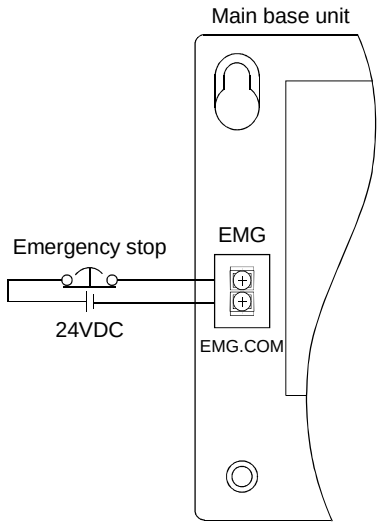
(4) Motion slots

When using the A172SENC and limit output module (A1SY42), load them into P I/O (motion slots) of the main base.



(5) Main base unit emergency stop circuit

(a) By opening the main base unit emergency stop (EMG) circuit, it is possible to effect an emergency stop all axes of the separate servo amplifiers (MR-H-BN/MR-J2S-B/MR-J2-B) simultaneously.
After an emergency stop, eliminate the cause of the emergency stop and reset the emergency stop by closing the emergency stop circuit (turning EMG circuit ON). (In the event of an emergency stop, the servo error detection signal does not come ON.)
An example of emergency stop wiring connections is shown below.



(b) Do not use the emergency stop terminals of the separate servo amplifiers. If an independent emergency stop circuit is also required at a separate servo amplifier, provide an external circuit that shuts off the power supply to the separate servo amplifier.

(6) Connection and I/O assignment of base units

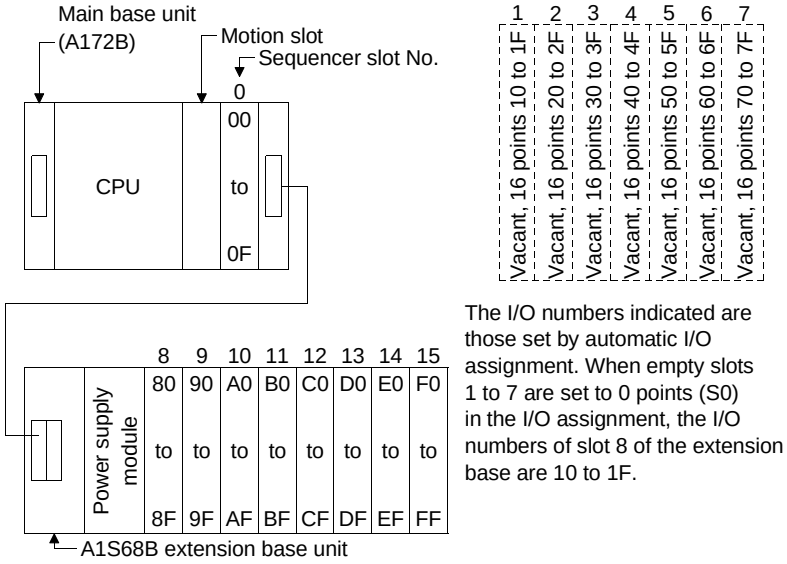
This section explains the way to connect the base units and the concept of sequence I/O assignment.

Use the extension cables for connection of the main base unit and extension base unit and connection of the extension base units.

When connecting the graphic operation terminal (GOT) by the bus, load it to the last extension base.

When automatic I/O assignment is executed (when the CPU module is started without I/O assignment being made on the positioning software package), the I/O numbers are automatically assigned, starting from 000, according to the number of occupying points of the I/O modules loaded to the sequencer slots, and each empty slot is assigned 16 points as occupied. Also, one base unit occupies eight sequencer slots, independently of the physical number of sequencer slots. Therefore, for example, when an extension base unit is connected to the A175B main base unit (one motion slot and four sequencer slots), the A175B main base unit has only four sequencer slots physically but automatic assignment is made as if four 16-point slots are occupied between the main and extension base units. To avoid the occupation of empty slots by automatic assignment, setting the corresponding slots as empty (S0) in the I/O assignment of the positioning software package allows the number of occupied points to be set to 0 in the I/O assignment.

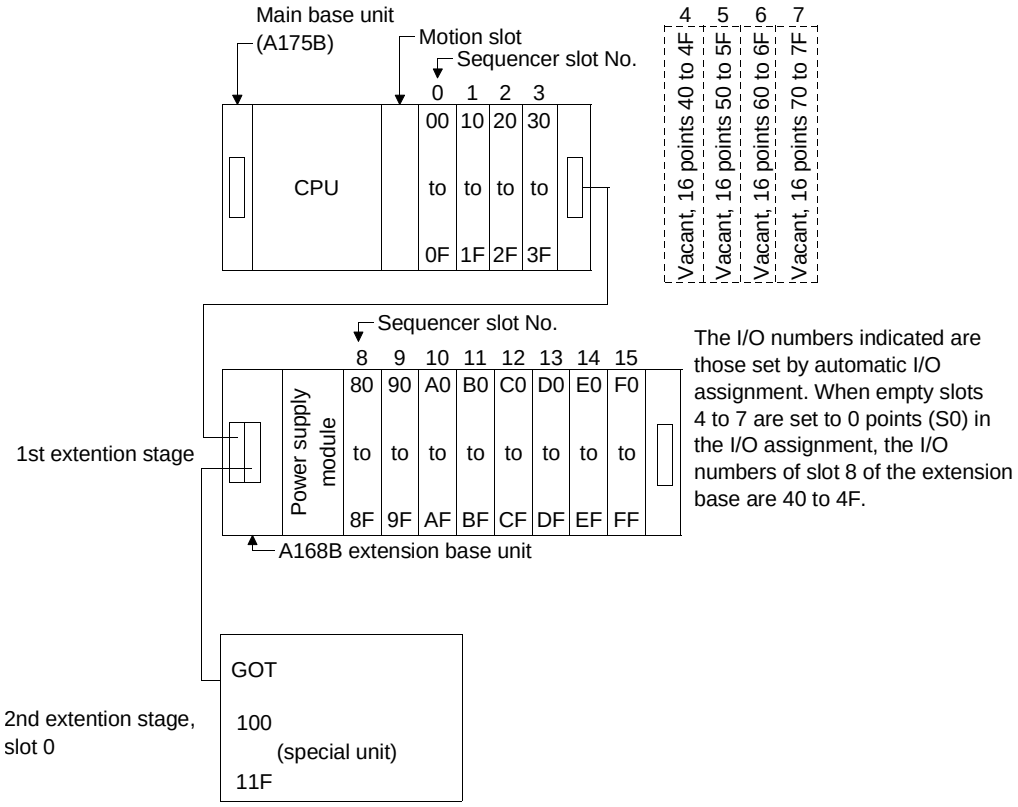
- Example of using the A172B main base (when a 16-point module is loaded to each slot)



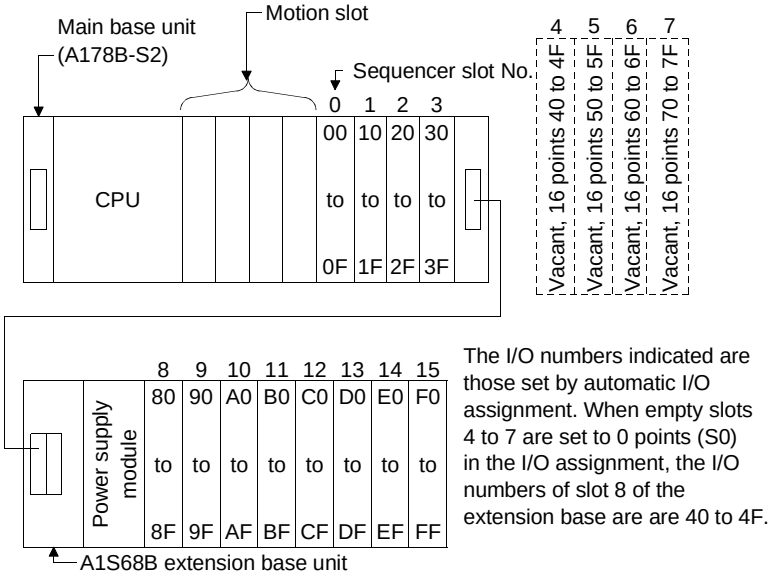
POINT

1) Max. number of actual I/O points
   A173UHCPU:2048 points, A172SHCPUN:1024 points, A171SHCPUN:512 points. The real I/O points can be used within the range of one extension base.
2) When using the bus connection type GOT, use the A168B.
3) Use the extension cable within 3m (9.84ft.) length.

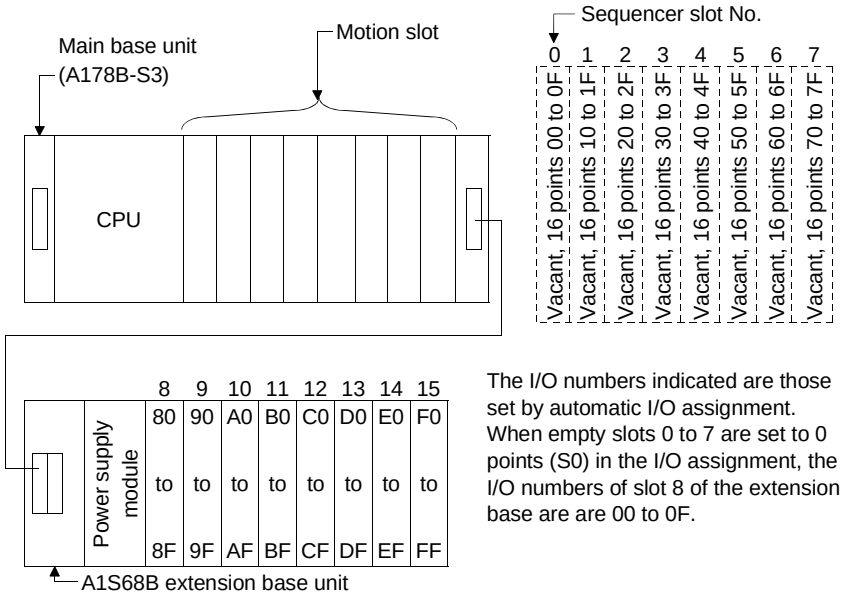
- Example of using the A175B main base (when a 16-point module is loaded to each slot)



- Example of using the A178B-S2 main base (when a 16-point module is loaded to each slot)



- Example of using the A178B-S3 main base (when a 16-point module is loaded to each slot)



The I/O numbers indicated are those set by automatic I/O assignment. When empty slots 0 to 7 are set to 0 points (S0) in the I/O assignment, the I/O numbers of slot 8 of the extension base are are 00 to 0F.

1.5.4 Manual Pulse Generator/Synchronous Encoder Interface Module

A172SENC receive external signals required for positioning control (motion control signals and tracking inputs), manual pulse generator inputs, and synchronous encoder inputs.

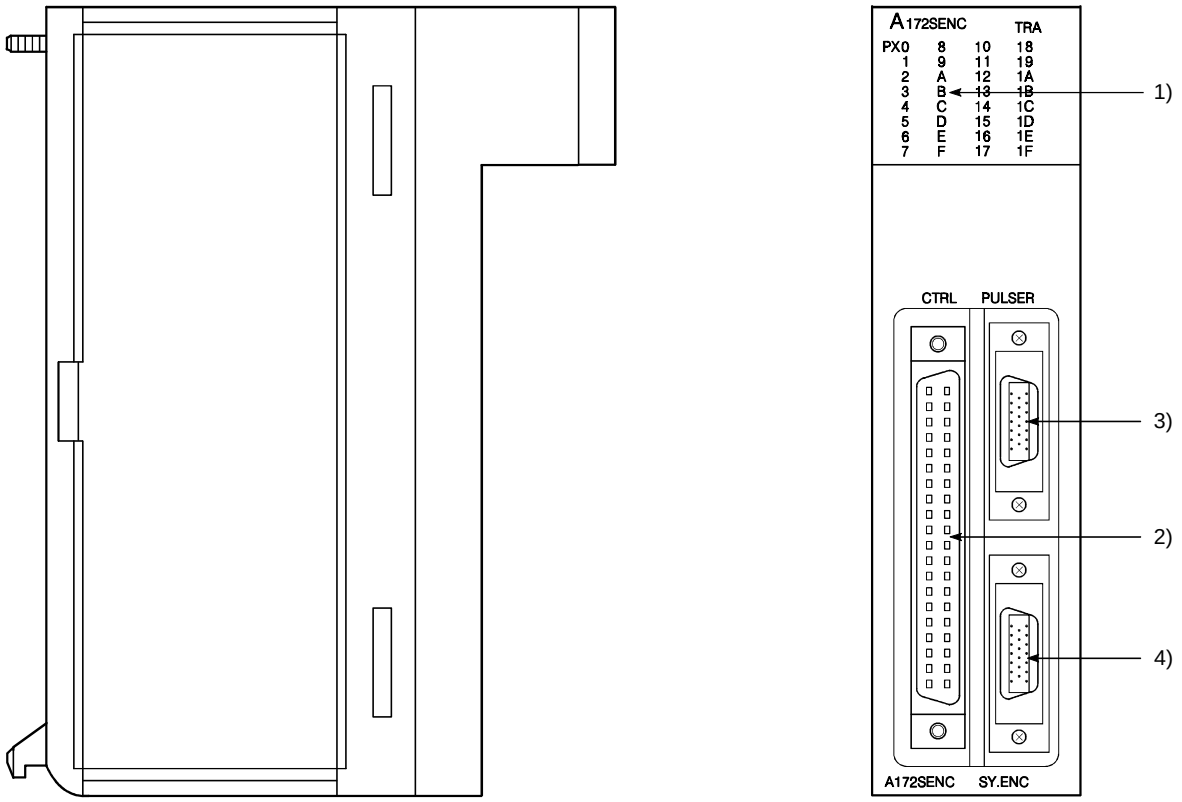
(1) Specifications

Table 1.9 A172SENC Specifications

Item		Specification
Model Name		A172SENC
Motion control signal input, tracking input	No. of inputs	Motion control signals: 32 points (8 points each for upper stroke limit, lower stroke limit, STOP input, near-zero point DOG/speed-position changeover signal) Tracking enable signal : 1 point Total : 33 points
	Rated input voltage	12/24VDC
	Rated input current	12VDC 2mA/24VDC 4mA
	Operating voltage range	10.2 to 26.4VDC
	ON voltage/current	7.0 VDC min./1.0 mA min.
	OFF voltage/current	1.8 VDC max./0.18 mA max.
	Response time	OFF → ON 2 ms max. ON → OFF 3 ms max.
	Tracking input response time	OFF → ON 0.5 ms max. ON → OFF 0.5 ms max.
Brake output	No. of outputs	1 point
	Rated load voltage	24 VDC
	Operating load voltage range	21.6 to 30 VDC (peak voltage 30 VDC)
	Maximum load current	0.1 A (max. rush current: 0.4A, 10 ms max.)
	Response time	OFF → ON 2 ms max. ON → OFF 2 ms max.
Manual pulse generator input or incremental synchronous encoder	No. of modules	1
	H voltage	3.0 to 5.25 V
	L voltage	0 to 1.0 V
	Maximum input frequency	100 kpps max.
	Applicable type	Voltage-output type (5 VDC), Recommended product: MR-HDP01 Differential-output type: 26LS31 or equivalent Selectable by connector wiring
Serial absolute synchronous encoder input	No. of modules	1
	Applicable types	MR-HENC
	Position detection method	Absolute
	Resolution	16384 PLS/rev
Power consumption (5 VDC)		0.42
Product weight (kg) (lb)		0.22 (0.49)

(2) Description of Parts

(a) A172SENC



No.	Name	Application
1)	LED indicators	Display the input status from external equipment and errors detected by self-diagnosis. LED: PX0 to PX1F — Description: Indicators to display the motion control signal input status of each axis. LED: TRA — Description: Input start signal from synchronous encoder.
2)	CTRL connector	Connector for motion control signal input and tracking signal input of each axis.
3)	PULSER connector	Manual pulse generator/incremental synchronous encoder input connector.
4)	SY.ENC connector	Serial absolute synchronous encoder input connector.

(3) Selection of A172SENC module and connection with external equipment

(a) Number of A172SENC modules

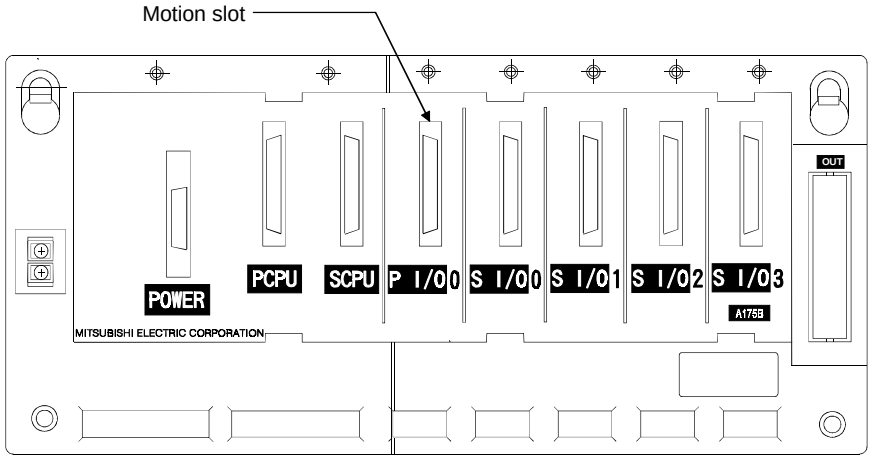
Determine the number of A172SENC modules according to the number of control axes which use such external signals as upper and lower stroke limit and near-zero point dog signals and the number of manual pulse generators/synchronous encoders used.

You can use up to four modules for the A173UHCPU or only one module for the A172SHCPUN or A171SHCPUN.

A172SENC Specifications

Signal/Connected External Equipment	Usable Number per A172SENC
Servo external signal	Upper stroke limit input Lower stroke limit input Stop signal input Near-zero point dog/speed-position change signal input } 8 points (for 8 axes) Tracking enable input: 1 point Electromagnetic brake command output: 1 point
Manual pulse generator/incremental synchronous encoder (Voltage/differential output type)	1 unit
Serial absolute synchronous encoder	1 unit

Load the A172SENC to P I/O (motion slot) of the main base.



(b) Connection of manual pulse generators/synchronous encoders

Manual pulse generators are available in voltage output type and differential output type, and synchronous encoders are available in voltage output/differential output type and serial absolute output type (Model: MR-HENC). Since these types differ in connectors and connection methods, design according to the connection system described below. (The synchronous encoders are used only in the SV22 virtual mode.)

In addition, the usable numbers of manual pulse generators and synchronous encoders differ between the CPU modules.

CPU Module	Manual Pulse Generator	Synchronous Encoder
A173UHCPU	3	4
A172SHCPUN/A171SHCPUN	1	1

1) Connection of voltage output type and differential output type manual pulse generators and incremental synchronous encoders

Use the PULSER connector at the A172SENC module front to connect any of the voltage output type and differential output type manual pulse generators and incremental synchronous encoders.

The pin layout and connection of the PULSER connector are described below.

PULSER connector

	PIN No.	Signal Name	PIN No.	Signal Name	
	1	SG	11	SG	
	2	Vacant	12	Vacant	
	3	HZ1	13	Vacant	
*2	4	HA1	14	HB1	*2
	5	SG	15	SG	
	6	P5	16	P5	
*3	7	HA2P	17	HA2N	*3
	8	HB2P	18	HB2N	
	9	HZ2P	19	HZ2N	
	10	Vacant	20	HPSEL	*1

Applicable connector model names
10120-3000VE connector
10320-52F0-008 connector cover (Manufactured by Sumitomo 3M) (Standard accessories)
*Also available as MR-CON1.

*1 Inputs from manual pulse generator switched by HPSEL. Unconnected selects voltage-output type, HPSEL=SG selects differential-output type.

*2, *3 Connect the manual pulse generator connector cable wires according to the output type of the manual pulse generator, as described below.

*2 Voltage -output type
Connect the A-phase signal to Pin 4 (HA1) and the B-phase signal to Pin 14 (HB1).

*3 Differential-output type
Connect the A-phase signal to Pin 7 (HA2P) and the A-phase inverse signal to Pin 17 (HA2N), the B-phase signal to Pin 8 (HB2P) and the B-phase inverse signal to Pin 18 (HB2N).

- Interface between PULSER connector and voltage-output manual pulse generator/incremental synchronous encoder

Input or Output	Signal Name		Pin No. PULSER Connector Voltage-Output Type	Wiring Example	Internal Circuit	Specification	Description
Input	Manual pulse generator, phase A	A+	4	A	1K	• Rated input voltage 5.5 VDC max. • HIGH level 3 VDC to 5.25 VDC/2 mA • LOW level 1 VDC max./ 5 mA min.	To connect manual pulse generator phases A,B • Pulse width 10μs min. 5μs min. 5μs min. (Duty ratio:50%) • Rise, fall time .....1μs max. • Phase difference Phase A Phase B 2.5μs min. (1) Positioning address increases if Phase A leads Phase B. (2) Positioning address decreases if Phase B leads Phase A.
		A–					
	Manual pulse generator, phase B	B+	14	Manual pulse generator/ synchronous encoder B	1K		
		B–					
	P5		6 16	5V			
	SG		1 5 11 15	0V			

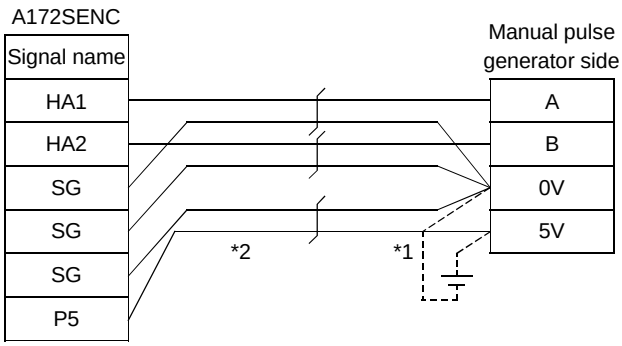
- Interface between PULSER connector and differential-output manual pulse generator/incremental synchronous encoder

Input or Output	Signal Name		Pin No. PULSER Connector Voltage-Output Type	Wiring Example / Internal Circuit	Specification	Description
Input	Manual pulse generator, phase A	A+	7	A, $\overline{A}$	• Rated input voltage 5.5 VDC max. • HIGH level 3 VDC to 5.25 VDC/2 mA max. • LOW level 1 VDC max./ 5 mA max.	To connect manual pulse generator phases A,B • Pulse width 10 μs min. 5 μs min. 5 μs min. (Duty ratio:50%) • Rise, fall time .....1 μs max. • Phase difference Phase A Phase B 2.5 μs min. (1) Positioning address increases if Phase A leads Phase B. (2) Positioning address decreases if Phase B leads Phase A.
		A–	17			
	Manual pulse generator, phase B	B+	8	B, $\overline{B}$		
		B–	18			
	P5		6 16	5V		
	SG		1 5 11 15	0V		

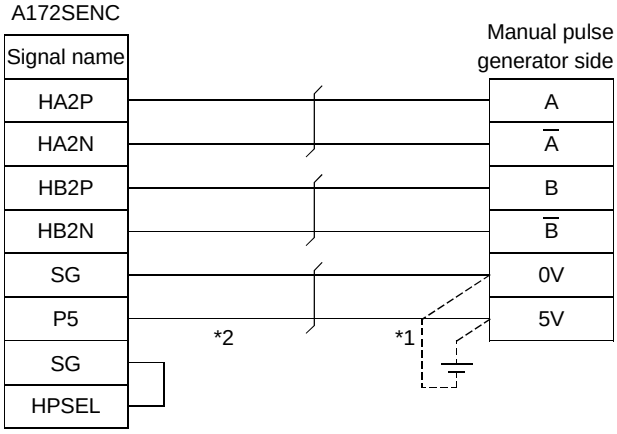
Manual pulse generator/ synchronous encoder

- Connection examples

Connection of voltage-output manual pulse generator



Connection of differential-output manual pulse generator



CAUTION

*1: The 5 VDC power supply from the A172SENC must not be connected if a separate power supply is used as the manual pulse generator power supply.
If a separate power supply is used as the manual pulse generator power supply, use a 5 V stabilized power supply. Any other power supply may cause a failure.

*2: Total connector cable length not to exceed 30 m (98.4 ft.)

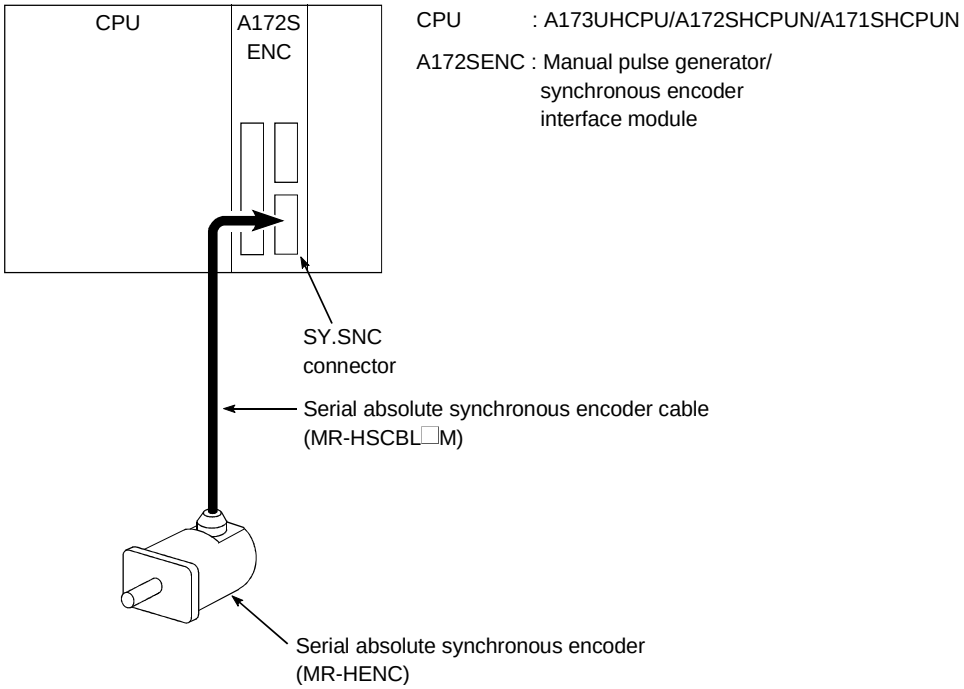
2) Connection of serial absolute synchronous encoder (MR-HENC)
Use the SY.ENC connector at the A172SENC module front to connect the serial absolute synchronous encoder (MR-HENC).
Use the MR-HSCBL□M encoder cable between the serial absolute synchronous encoder (MR-HENC) and SY.ENC connector.
The pin layout and connection of the SY.ENC connector are described below.

SY.ENC connector

PIN No.	Signal Name	PIN No.	Signal Name
10	Vacant	20	SD
9	Vacant	19	Vacant
8	P5	18	Vacant
7	P5	17	SG
6	Vacant	16	P5
5	Vacant	15	SG
4	MR	14	BAT
3	MRR	13	MDR
2	SG	12	MD
1	SG	10	Vacant

Applicable connector model names PCR-S20FS connector PCR-LS20LA1 connector cover (Manufactured by HONDA TSUSHIN KOGYO CO.,LTD

3) Interface with external equipment
The interface between the SY.ENC connector and external equipment is described below.
(a) Wiring precautions
1) Tighten the screws after connecting the connector.



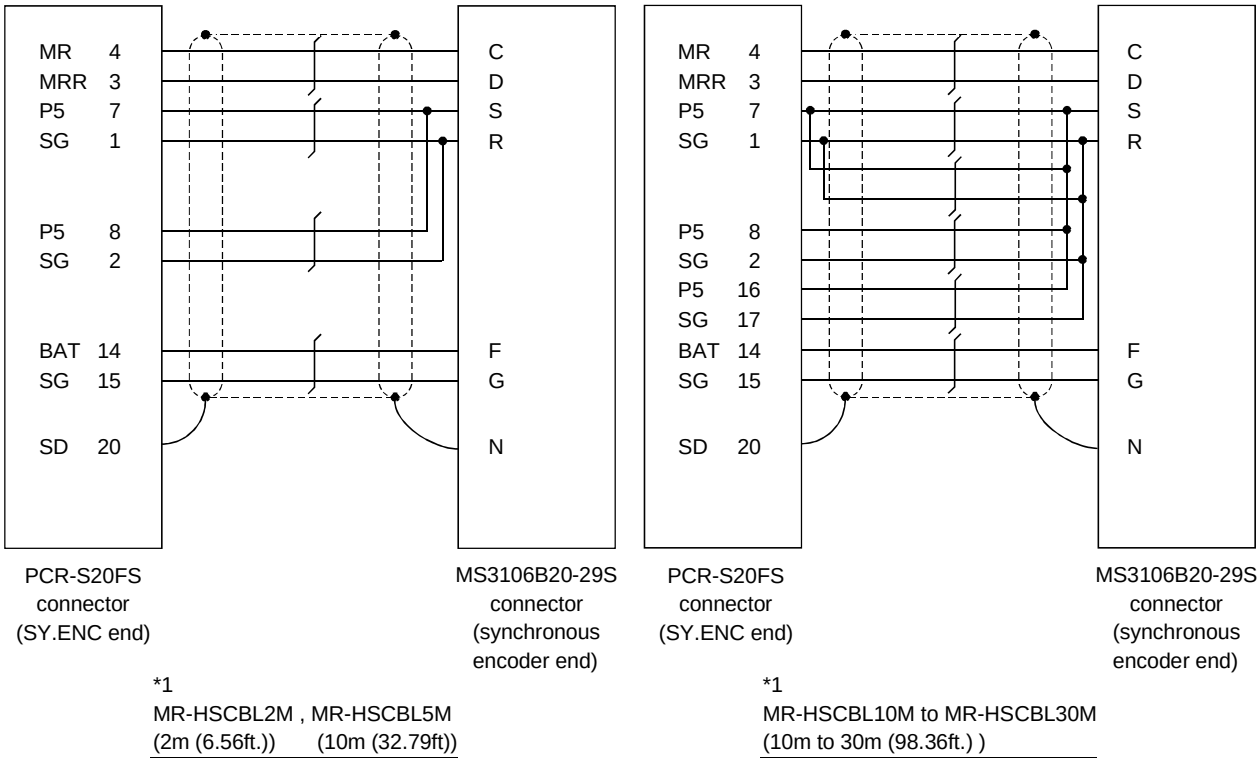
CPU : A173UHCPU/A172SHCPUN/A171SHCPUN

A172SENC : Manual pulse generator/ synchronous encoder interface module

⚠ CAUTION

- ⚠ Connect the SY.ENC connector to external equipment using a shielded cable. To reduce electromagnetic interference, do not position the cable close to, or bundle it with, power or main circuit cables. A clearance of at least 200 mm (0.66 inch) to other cables is required.
- ⚠ Connect the shield wire of the shielded cable to the FG terminal of the external equipment.
- ⚠ When increasing the cable length, use the cable within 30m (98.36 ft). Note that the cable should be run in the shortest possible distance to avoid induced noise.
- ⚠ Always wire the cables when power is off. Not doing so can damage the output circuit if any of the output signal cables makes contact with the power supply or the output signal cables make contact with each other.
- ⚠ Use extreme care when wiring the cables. Wrong wiring can damage the internal circuitry.

- Details of encoder cable connections

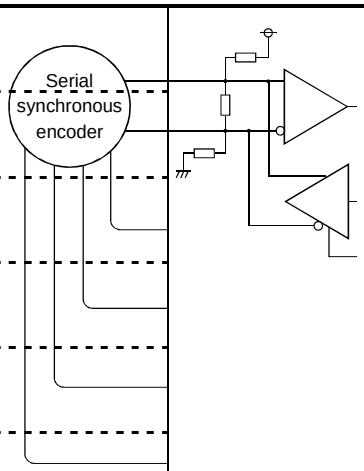


Model name for encoder connector set (MR-JSCNS)*2

*1 : Encoder cables are the same as HA-UH□K,HC-SF/RF/UF (2000r/min) series motor cables.

*2: The encoder connector set may also be used as the detector connector set for HA-UH□K,HC-SF/RF/UF (2000r/min) series motor.

- Interface between SY.ENC connector and external equipment

Input or Output	Signal Name	Pin No. SY.ENC Connector	Wiring Example / Internal Circuit	Specification	Description
Input	MR	4		• Transmission method: serial communications • Position detection method: absolute	
	MRR	3			
	P5	*3 7, 8, 16			
	SG	*3 1, 2, 15, 17			
	BAT	14			
	SD	20			

*3: Connect when using MR-HSCBL10M to MR-HSCBL30M.

(c) Connection of servo external signals

There are the following servo external signals.

The A172SENC is assigned a set of input numbers per axis, with the exception of the tracking enable signal and electromagnetic brake command output. Make the system settings of the positioning software package to determine the I/O numbers corresponding to the axis No.s.

Servo External Signal	Application	Number of Points on One A172SENC
Upper stroke limit input (FLS)	For detection of upper and lower stroke limits	8 points each (1 point/1 axis each)
Lower stroke limit input (RLS)		
Stop signal input (STOP)	For stopping under speed or positioning control	
Near-zero point dog/speed-position change input (DOG/CHANGE)	For detection of near-zero point dog at near-zero point dog or count type home position return or for switching from speed to position under speed-position change control.	
Tracking enable signal input	Synchronous encoder input start signal	1 point each
Electromagnetic brake command output	For command output to electromagnetic brake	

Use the CTRL connector at the A172SENC module front to connect the servo external signals.
The pin layout and connection of the CTRL connector are described below.
The following pin layout is the front view as seen from the CTRL connector front of the A172SENC.

POINT
Signal No.s 1 to 8 can be assigned to the specified axes. To make assignment, make the system settings of the positioning software package.

CTRL connector

Signal No.	External input signal name	PIN No.	Signal Name	PIN No.	Signal Name	External input signal name	Signal No.
		A1	BRK.COM	B1	COM		
		A2	BRK	B2	COM		
		A3	Vacant	B3	Vacant		
		A4	Vacant	B4	TRA		
8	DOG/CHANGE	A5	PX1F	B5	PXF	DOG/CHANGE	4
	STOP	A6	PX1E	B6	PXE	STOP	
	RLS	A7	PX1D	B7	PXD	RLS	
	FLS	A8	PX1C	B8	PXC	FLS	
7	DOG/CHANGE	A9	PX1B	B9	PXB	DOG/CHANGE	3
	STOP	A10	PX1A	B10	PXA	STOP	
	RLS	A11	PX19	B11	PX9	RLS	
	FLS	A12	PX18	B12	PX8	FLS	
6	DOG/CHANGE	A13	PX17	B13	PX7	DOG/CHANGE	2
	STOP	A14	PX16	B14	PX6	STOP	
	RLS	A15	PX15	B15	PX5	RLS	
	FLS	A16	PX14	B16	PX4	FLS	
5	DOG/CHANGE	A17	PX13	B17	PX3	DOG/CHANGE	1
	STOP	A18	PX12	B18	PX2	STOP	
	RLS	A19	PX11	B19	PX1	RLS	
	FLS	A20	PX10	B20	PX0	FLS	

Applicable connector model name ..... FCN-361J040-AU connector (manufactured by Fujitsu) (Standard accessories)
FCN-360C040-B connector cover (Standard accessories)

DOG/CHANGE, STOP, RLS, FLS functions of each axis (1 to 8)
DOG/CHANGE.....Near-zero point dog/speed-position change signal STOP .....Stop signal RLS .....Lower stroke limit FLS.....Upper stroke limit

For signal details, refer to the programming manual.

- Interface between CTRL connector and servo external signal

Input or Output	Signal Name	Pin Number CTRL Connector				Wiring Example	Internal Circuit	Specification	Description
Input	PX0, PX4, PX8, PXC PX10, PX14, PX18, PX1C	B20 A20	B16 A16	B12 A12	B8 A8	Upper stroke limit input	6.8kΩ	• Supply voltage 12 to 24 VDC (10.2 to 26.4 VDC, stabilized power supply) • HIGH level 7.0 VDC min./1.0mA min. • LOW level 1.8 VDC max./0.2 mA max.	FLS
	PX1, PX5, PX9, PXD PX11, PX15, PX19, PX1D	B19 A19	B15 A15	B11 A11	B7 A7	Lower stroke limit input	6.8kΩ		RLS
	PX2, PX6, PXA, PXE PX12, PX16, PX1A, PX1E	B18 A18	B14 A14	B10 A10	B6 A6	Stop signal input	6.8kΩ		STOP
	PX3, PX7, PXB, PXF PX13, PX17, PX1B, PX1F	B17 A17	B13 A13	B9 A9	B5 A5	Near point DOG/ speed-position changeover command	6.8kΩ		DOG/CHANGE
	TRA	B4				TRA signal	6.8kΩ		Tracking enable signal input. • Generates interrupts to A173UHCPU/ A172SHCPUN/ A171SHCPUN. • Starts counter operation.
	Power	B1 B2				- + 5VDC to 24VDC			Common terminals for motion control signals, external signal and TRA.
Output	BRK	A2				Brake + - 24VDC		Rated load voltage 24 VDC (21.6 to 30 VDC), 0.1 mA max.	Brake signal output
	BRK, COM	A1							

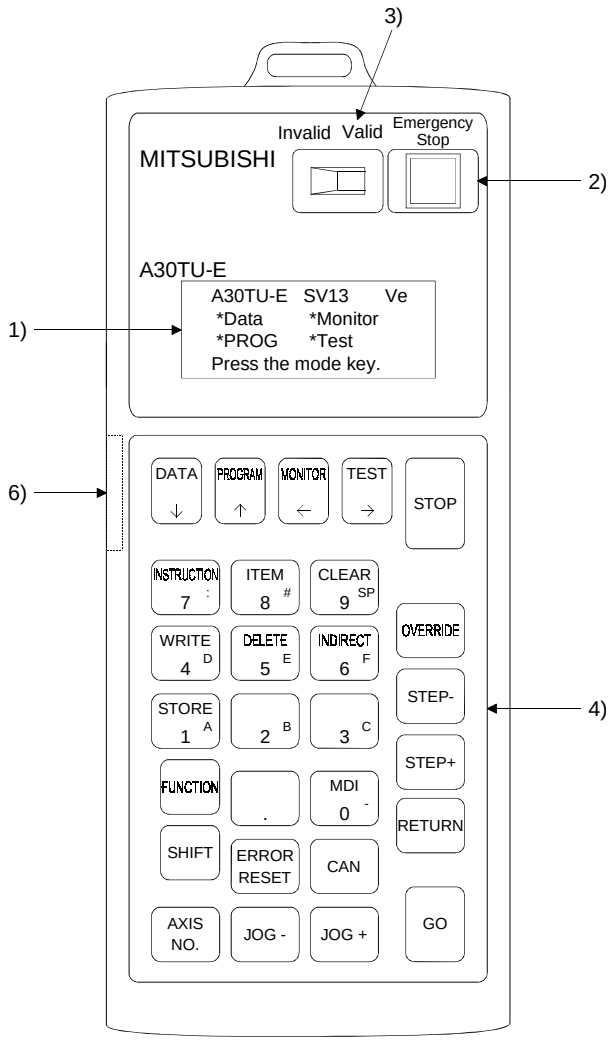
⚠ CAUTION

⚠ Always use a shielded cable for connection of the SY.ENC connector and external equipment, and avoid running it close to or bundling it with the power and main circuit cables to minimize the influence of electromagnetic interference. (Separate them more than 200mm (0.66 inch) away.)
⚠ Connect the shield wire of the connection cable to the FG terminal of the external equipment.
⚠ Make parameter setting correctly. Incorrect setting may disable the protective functions such as stroke limit protection or may not provide the brake output, damaging the module.
⚠ Always wire the cables when power is off. Not doing so can damage the output circuit if any of the output signal cables makes contact with the power supply or the output signal cables make contact with each other.
⚠ Use extreme care when wiring the cables. Wrong wiring can damage the internal circuitry.

1.5.5 Teaching Unit

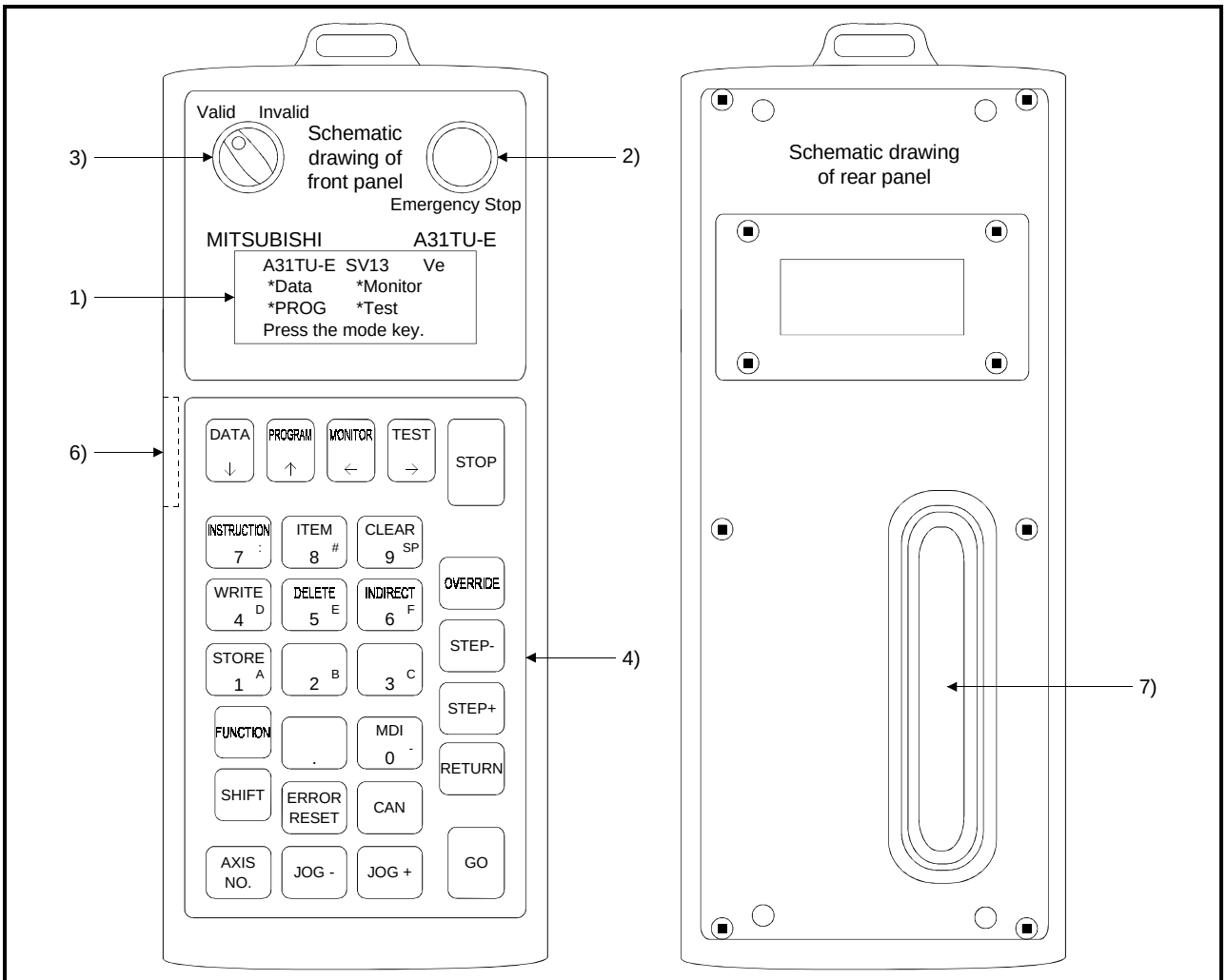
(1) Names of parts

(a) A30TU-E



No.	Name	Application
1)	Display	4-line × 16-character LCD display With back-lighted auto light off With contrast adjusting knob
2)	Emergency stop key	Shuts off servo power to stop all operations.
3)	Valid/Invalid switch	Changes over the operations of the teaching box between valid and invalid.
4)	Operation keys	Operation key switches of the teaching box
5)	Internal buzzer	Buzzer sounds when key input or any alarm occurs. It is also possible to set the buzzer so that it does not sound for key input.
6)	Contrast adjusting knob	For contrast adjustment of display

(b) A31TU-E



No.	Name	Application
1)	Display	4-line × 16-character LCD display With back-lighted auto light off With contrast adjusting knob
2)	Emergency stop key	Shuts off servo power to stop all operations.
3)	Valid/Invalid switch	Changes over the operations of the teaching box between valid and invalid.
4)	Operation keys	Operation key switches of the teaching box
5)	Internal buzzer	Buzzer sounds when key input or any alarm occurs. It is also possible to set the buzzer so that it does not sound for key input.
6)	Contrast adjusting knob	For contrast adjustment of display
7)	Deadman switch	Turns on the switch to enable servo operation: turns off the switch to shut off the servo power.

POINT

A dead-man switch is used for jogging operated from the teaching box. To operate the switch, press and hold it down. Releasing the deadman switch turns off servo power, bringing the servo motor to an immediate stop.

(2) Selection of teaching unit and connection with CPU module

(a) Selection of teaching unit

There are the A30TU-E and A31TU-E teaching units. Refer to the following table for selection.

Selection of Teaching Unit

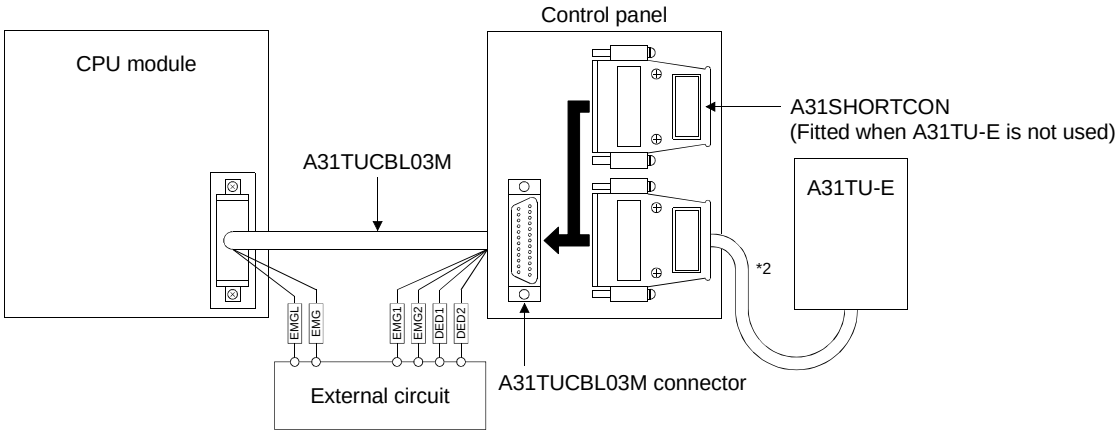
Comparison	A30TU-E	A31TU-E
Dead-man switch *1	Without	With
Emergency stop	With (signal on semiconductor level)	With (signal on relay level)
Connection with CPU	Directly connectable	Directly unconnectable Via A31TUCBL03M External circuit required (In direct connection, CPU module does not operate.)

*1: Releasing the deadman switch turns off servo power.

(b) Connection of A31TU-E unit (teaching unit with deadman switch) and CPU module

To connect the A31TU-E teaching unit with deadman switch and the CPU module, use the A31TUCBL03M for connection within the panel and plug its A31TU-E side connector into the operator panel surface for A31TU-E connection. When using the A31TU-E unit, use it by plugging it into the connector on the operator panel surface. When not using the A31TU-E, fit the A31SHORTCON into the connector on the operator panel surface.

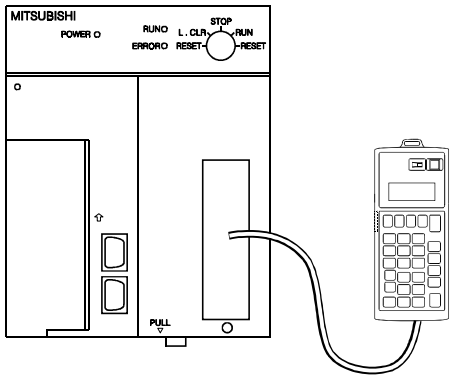
The A31TUCBL03M's signal wires connected to the external circuit, e.g. EMG and EMGL, are used for external safety circuit connection for the emergency stop switch and deadman switch of the A31TU-E. Refer to Section 2.3(2) for details of the external circuit.



*2: The CPU module does not operate if the A31TU-E and CPU module are connected directly.

POINT
When using the A31TU-E, be sure to use the A31TUCBL03M. When the A31TU-E is not connected, be sure to connect the A31SHORTCON. Failing to do this could result in the system entering an emergency stop state. An external circuit is essential to form a safety circuit. (For details of external circuit configuration, refer to the section 2.3.)

(c) Connection of A30TU-E and CPU module



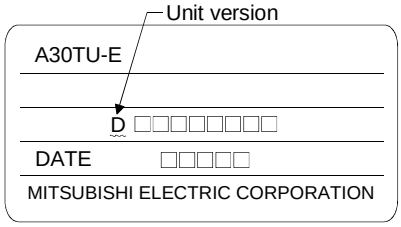
(3) Applicable teaching unit version

Teaching unit version applicable to CPU module is as follows:

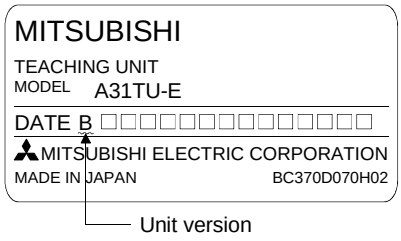
Model Name	Applicable Version
A30TU-E	D or later
A31TU-E	B or later

Teaching unit version is marked on the rated name plate at the rear panel of the unit.

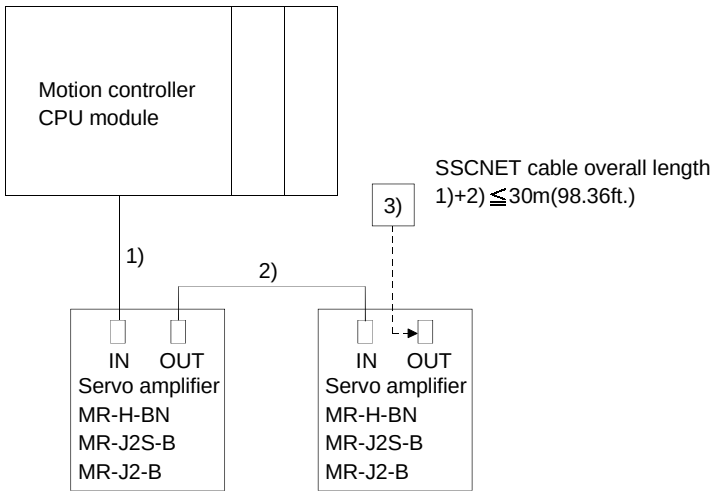
(4) A30TU-E rated name plate



(5) A31TU-E rated name plate



1.5.6 SSCNET Cables and Termination Resistor and Their Connection Method



No.	Product	Model	Description
1)	SSCNET cable	MR-HBUS□M Cable length within □ (0.5m (1.64ft.), 1m (3.25ft.), 5m (16.39ft.))	For connection of CPU and servo amplifier (MR-H-BN)
2)			For connection of servo amplifier (MR-H-BN) and servo amplifier (MR-H-BN)
1)		MR-J2HBUS□M-A Cable length within □ (0.5m (1.64ft.), 1m (3.28ft.), 5m (16.39ft.))	For connection of CPU and servo amplifier (MR-J2-B)
2)			For connection of servo amplifier (MR-H-BN) and servo amplifier (MR-J2S-B/MR-J2-B)
2)		MR-J2HBUS□M Cable length within □ (0.5m (1.64ft.), 1m (3.28ft.), 5m (16.39ft.))	For connection of servo amplifier (MR-J2S-B/MR-J2-B) and servo amplifier (MR-J2S-B/MR-J2-B)
3)	Termination resistor	MR-TM	Fitted to the SSCNET's last servo amplifier (MR-H-BN).
		MR-A-TM	Fitted to the SSCNET's last servo amplifier (MR-J2S-B/MR-J2-B).

(1) Performance specifications

(a) MR-HBUS□M

Item / Model	MR-HBUS05M	MR-HBUS1M	MR-HBUS5M
Cable length (m (ft.))	0.5 (1.64)	1 (3.28)	5 (16.39)

(b) MR-J2HBUS□M (-A)

Item / Model	MR-J2HBUS05M (-A)	MR-J2HBUS1M (-A)	MR-J2HBUS5M (-A)
Cable length (m (ft.))	0.5 (1.64)	1 (3.28)	5 (16.39)

(2) Connection of CPU module and servo amplifiers

This section explains how to connect the CPU module.

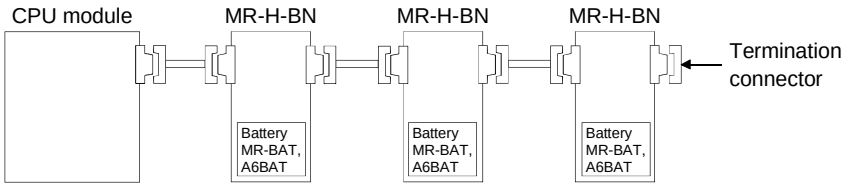
Use the SSCNET to connect the CPU module and servo amplifiers. When using the A172SHCPUN/A171SHCPUN, only one line of SSCNET is available for servo amplifier connection (use SSCNET1). The A173UHCPU can use up to four lines for servo amplifier connection. One line of SSCNET allows connection of up to eight servo amplifies.

As the SSCNET cables and termination connector used depend on the servo amplifiers, refer to the following connection example.

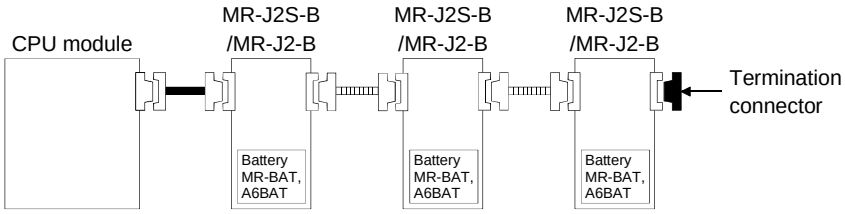
The SSCNET cables and termination connector used in the connection example are any of the models shown in the following table.

Name	Model Name	Depiction in Connection Example
SSCNET cable	MR-HBUS□M	
	MR-J2HBUS□M	
	MR-J2HBUS□M-A	
Termination connector	MR-TM	
	MR-A-TM	

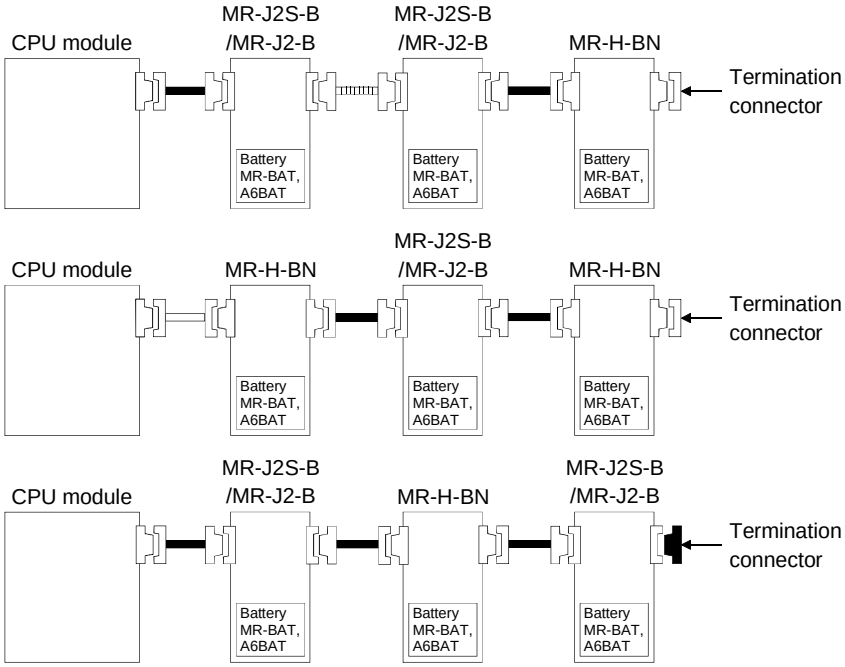
(a) MR-H-BN configuration



(b) MR-J2S-B/MR-J2-B configuration



(c) MR-J2S-B/MR-J2-B+MR-H-BN configuration



(3) Servo amplifier axis numbers and axis No. (dno.) setting

The axis No.s are used to set the axis numbers of the SSCNET-connected servo amplifiers in the program. Axis No.s 1 to 32 can be set for the A173UHCPU, 1 to 8 for the A172SHCPUN, and 1 to 4 for the A171SHCPUN. To set the axis No.s, assign the axis No.s to the axis numbers set with the axis selection switches (rotary switch) of the servo amplifiers (Positions 0 to 7 of the rotary switch correspond to d1 to d8 on the system settings screen. (On the A171SHCPUN, positions 0 to 3 of the rotary switch correspond to d1 to d4.)) to each SSCNET line in the system settings of the positioning software package. You cannot set the same axis number and axis No. (dno.) more than once.

Correspondences between dno.s and servo amplifier rotary switches

dno. *1	SSCNET Line	Servo Amplifier's Rotary Switch
1	1	“0”
2	1	“1”
3	1	“2”
4	1	“3”
5	1	“4”
6	1	“5”
7	1	“6”
8	1	“7”

dno. *1	SSCNET Line	Servo Amplifier's Rotary Switch
1	2	“0”
2	2	“1”
3	2	“2”
4	2	“3”
5	2	“4”
6	2	“5”
7	2	“6”
8	2	“7”

dno. *1	SSCNET Line	Servo Amplifier's Rotary Switch
1	3	“0”
2	3	“1”
3	3	“2”
4	3	“3”
5	3	“4”
6	3	“5”
7	3	“6”
8	3	“7”

dno. *1	SSCNET Line	Servo Amplifier's Rotary Switch
1	4	“0”
2	4	“1”
3	4	“2”
4	4	“3”
5	4	“4”
6	4	“5”
7	4	“6”
8	4	“7”

*1: dno. is the servo amplifier axis numbers displayed in the system settings of the positioning software package. Set the axis No. relative to the dno. in system settings.

1.5.7 Battery

This section describes the battery specifications and handling precautions.

(1) Battery in CPU module

(a) Specifications

The specifications of the battery for memory back-up are shown in the table below.

Table 1.10 Battery Specifications

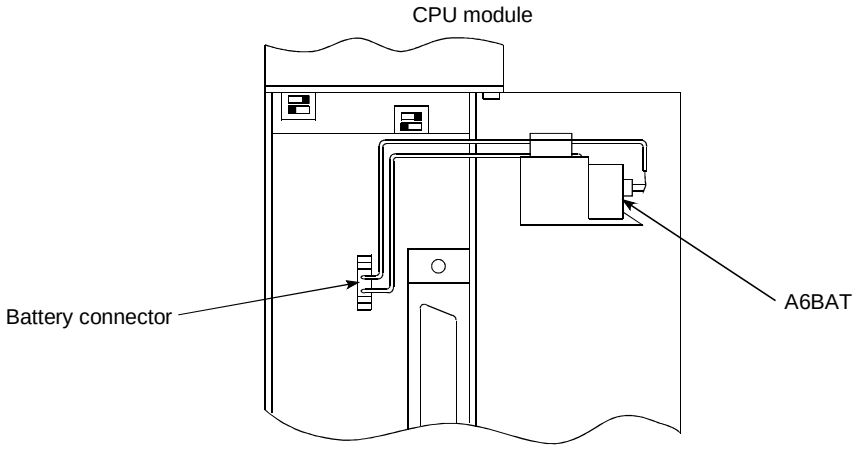
Item \ Model Name	A6BAT
Nominal voltage	3.6 VDC
Battery warranty period	5 years
Total power interruption	The range is as follows. for details, see Section 5.3. Min. 5400 hrs.
Applications	(1) IC-RAM back-up and memory back-up functions (2) Back up for the absolute data of a synchronous encoder
External dimensions mm (inch)	φ16(0.63)×30(1.18)

(b) Mounting the battery

To reduce battery deterioration during distribution and storage, the leads are not connected during shipment.

Connect the battery lead connector to the battery connector on the CPU module printed circuit board when using the CPU module as follows:

- Using sequence programs in the CPU module internal user program area;
- Using the power failure holding functions.



⚠ CAUTION

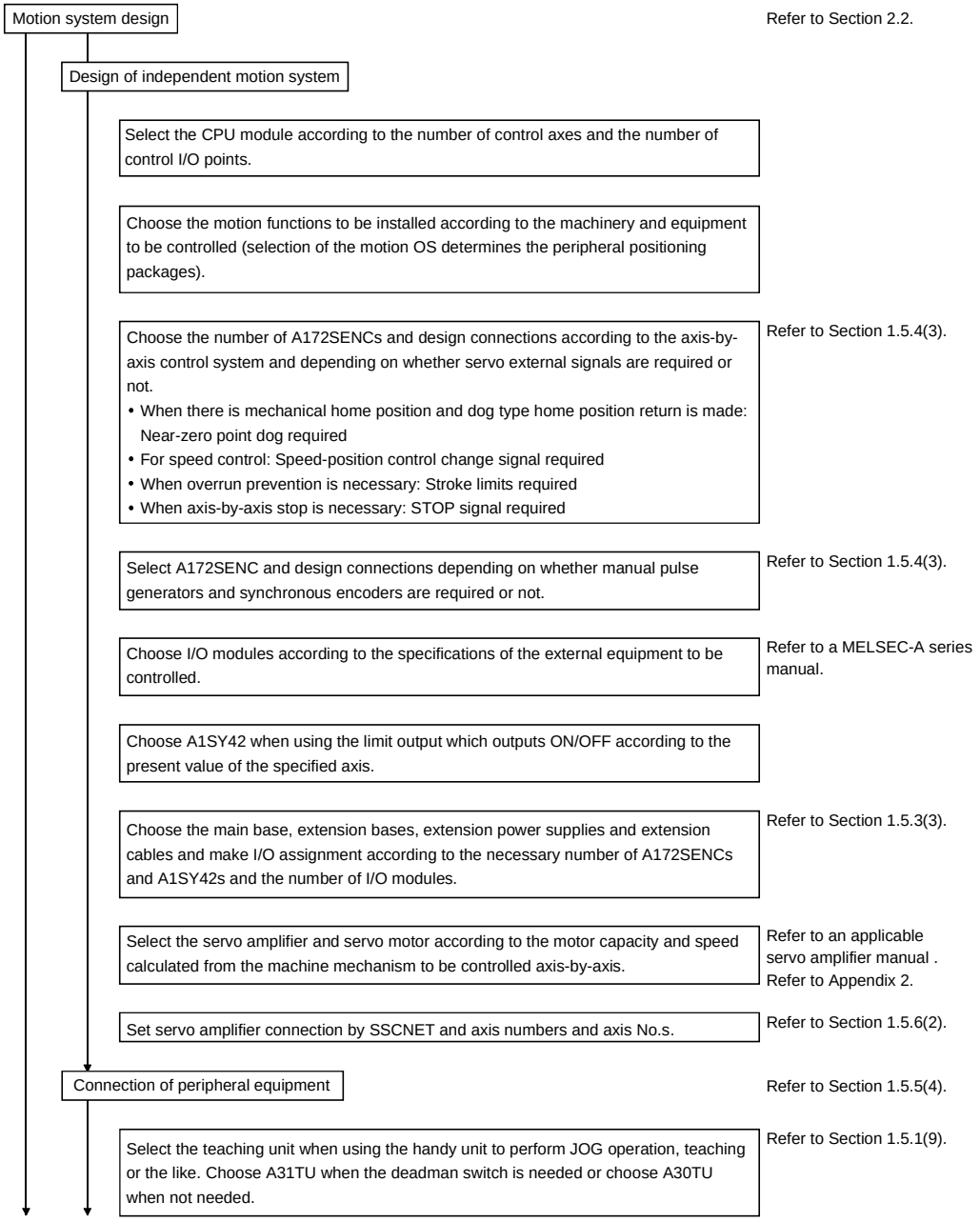
⚠ Do not short a battery.
⚠ Do not disassemble a battery.
⚠ Do not burn a battery.
⚠ Do not overheat a battery.
⚠ Do not solder the battery terminals.

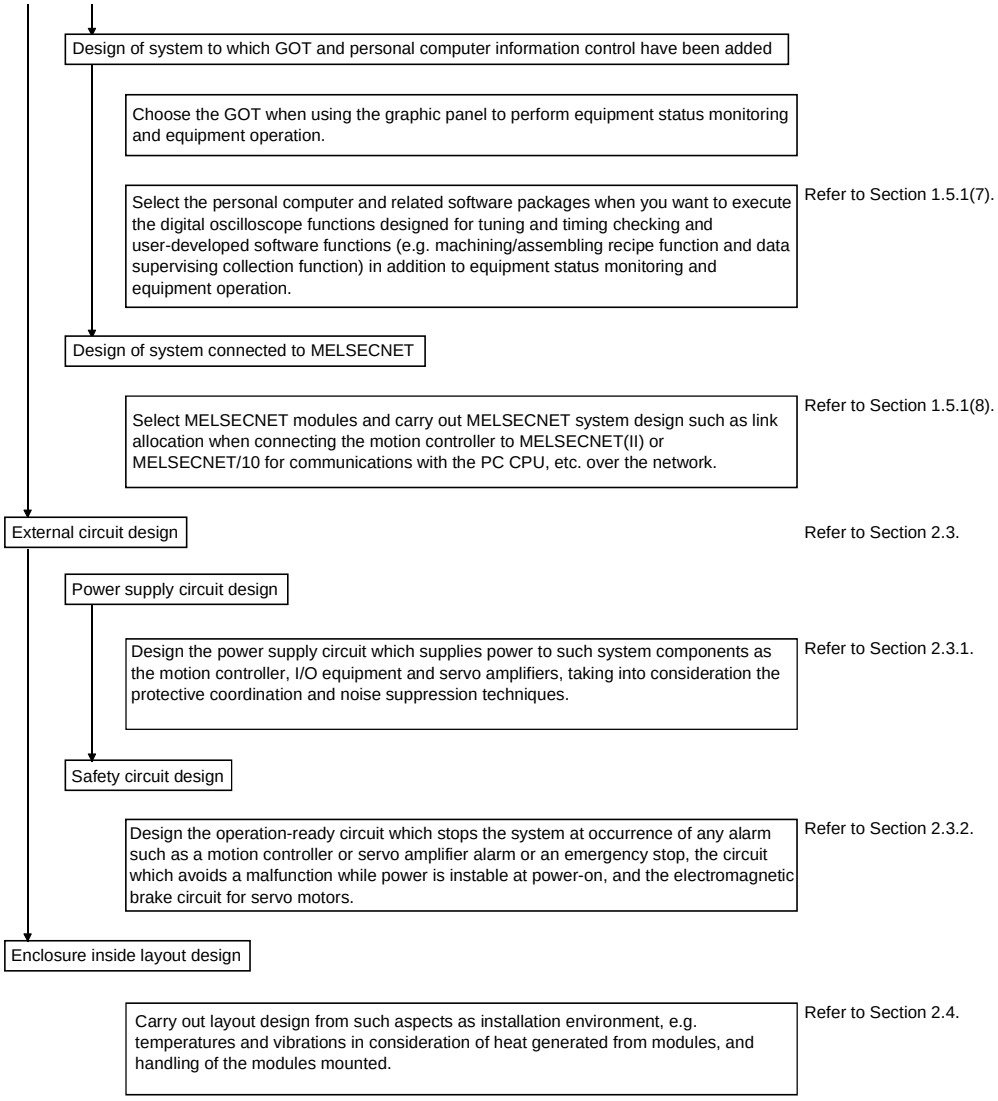
2. DESIGN

This chapter provides those who will design and manage the motion system with the procedures and instructions necessary to design the motion system.
For the system and parameter settings and programming method of the motion system, refer to the operating and programming manuals.
This chapter does not describe the selection of the amplifiers, motors and MELSEC-A series (I/O modules).
Refer to the corresponding manuals.

2.1 System Designing Procedure

Design the system which uses the motion controller in the following procedure.



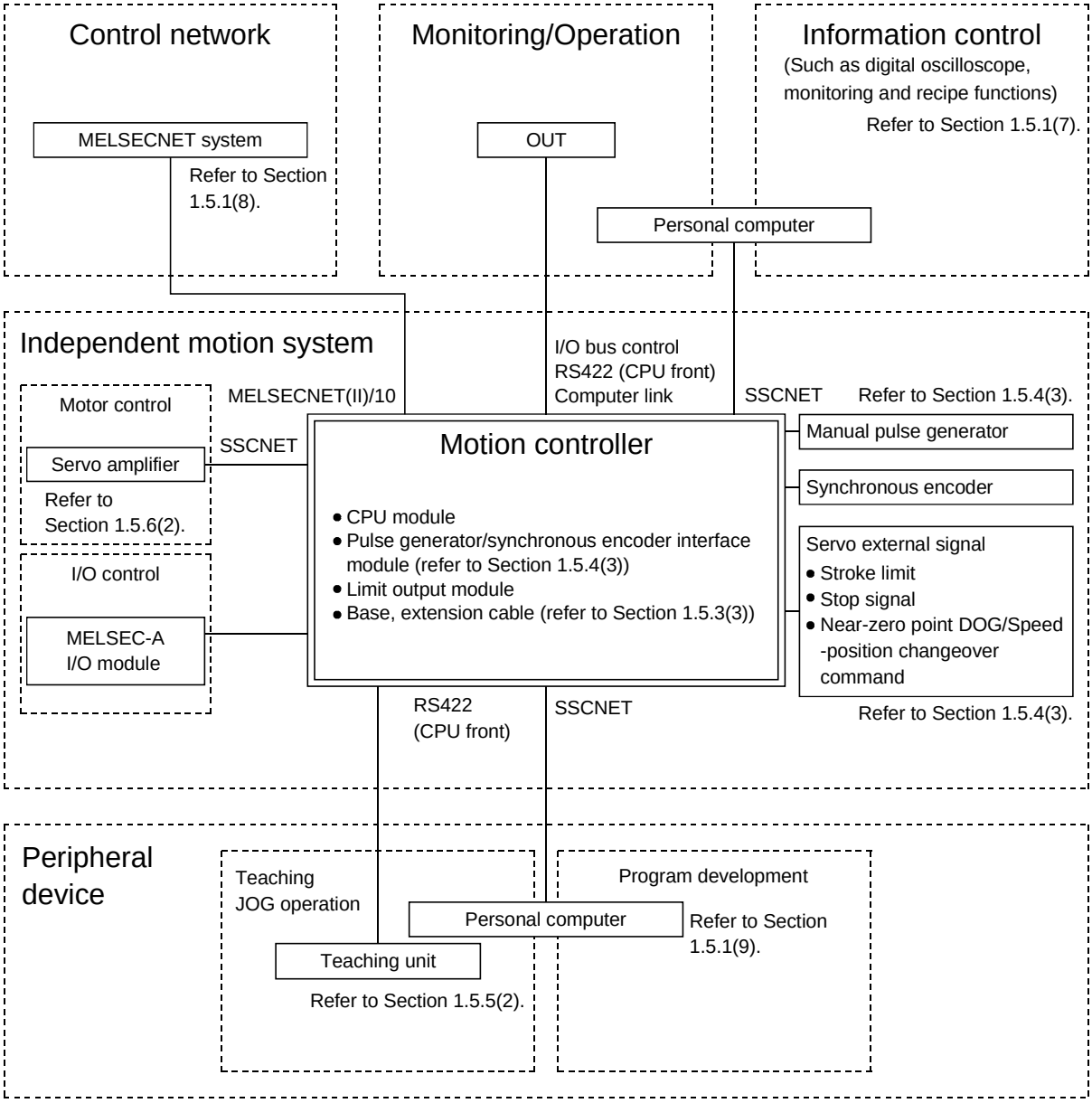

Design of system to which GOT and personal computer information control have been added
Choose the GOT when using the graphic panel to perform equipment status monitoring and equipment operation.
Select the personal computer and related software packages when you want to execute the digital oscilloscope functions designed for tuning and timing checking and user-developed software functions (e.g. machining/assembling recipe function and data supervising collection function) in addition to equipment status monitoring and equipment operation.
Refer to Section 1.5.1(7).
Design of system connected to MELSECNET
Select MELSECNET modules and carry out MELSECNET system design such as link allocation when connecting the motion controller to MELSECNET(II) or MELSECNET/10 for communications with the PC CPU, etc. over the network.
Refer to Section 1.5.1(8).
External circuit design
Refer to Section 2.3.
Power supply circuit design
Design the power supply circuit which supplies power to such system components as the motion controller, I/O equipment and servo amplifiers, taking into consideration the protective coordination and noise suppression techniques.
Refer to Section 2.3.1.
Safety circuit design
Design the operation-ready circuit which stops the system at occurrence of any alarm such as a motion controller or servo amplifier alarm or an emergency stop, the circuit which avoids a malfunction while power is instable at power-on, and the electromagnetic brake circuit for servo motors.
Refer to Section 2.3.2.
Enclosure inside layout design
Carry out layout design from such aspects as installation environment, e.g. temperatures and vibrations in consideration of heat generated from modules, and handling of the modules mounted.
Refer to Section 2.4.

CAUTION

- Provide appropriate circuits external to the servo system CPU to prevent cases where danger may result from abnormal operation of the overall system in the event of a power supply fault or servo system CPU failure.
- Mount each controller, servo amplifier, servomotor, and regenerative resistor on a non-flammable material. Fire may result if they are mounted on or near a flammable material.
- Take measures to cut off the servo amplifier power supply if the controller or servo amplifier fails. Large currents continuing to flow can cause fires.
- If a regenerative resistor is used, ensure that an alarm signal cuts off the power supply, otherwise damage to the regenerative transistor, overheating of the regenerative resistor, or even fire may result.
- To prevent fires, take flameproofing measures inside the control box where the servo amplifier and regenerative resistor are located and use non-flammable wiring.
- Do not apply a voltage to terminals which exceeds the voltage prescribed in this manual or the instruction manuals for other products used. Incorrect voltage can cause destruction of, or damage to, the equipment.
- Correct the terminals correctly. Incorrect connection can cause destruction of, or damage to, the equipment.
- Ensure polarity is correct. Incorrect polarity can cause destruction of, or damage to, the equipment.
- The servo amplifier cooling fins, regenerative resistor, and servomotors become hot during operation and can remain hot for some time after the power is turned off. Do not touch these parts or burn injuries may result.
- To avoid injury, turn off the power before touching servomotor shafts or machinery connected to them.
- To avoid injury, do not approach machinery during trial or teaching operation.
- Connect a leak breaker to the controller and servo amplifier power supply.
- Provide an electromagnetic contactor for servo amplifiers and other equipment for which the instruction manual prescribes an electromagnetic contactor to cut off the power in the event of an error.
- Provide an external emergency stop circuit to instantaneously stop operation and cut off power.
- Use controllers, servo amplifiers, servomotors, and regenerative resistors in combinations prescribed in this manual and the instruction manuals for other products used. Incorrect combinations can cause damage to the system or fire.
- If used in systems for which safety standards apply (such as robot systems), all controllers, servo amplifiers, and servomotors must meet the prescribed safety standards.
- Configure safety circuits external to the controller or servo amplifiers if their abnormal operation could cause axis motion in a direction other than the safe operating direction for the system.
- Use dynamic braking on servomotors if free running after an emergency stop, servo OFF, or a power cut is a problem.
- Consider the overrun distances of the system, even if dynamic braking is used.
- Use both dynamic braking and electromagnetic braking on servomotors if vertical falling of axes after an emergency stop, servo OFF, or a power cut is a problem.
- Use the dynamic brake module to stop servomotors when an emergency error or other error occurs to turn off the servomotors. Do not use it to stop the servomotors during normal operation.
- The electromagnetic brake incorporated in a servomotor is intended for holding only. Do not use it during normal operation.
- Design systems with sufficient mechanical allowance for a safe stop if an axis passes the stroke-end limit switch at maximum speed.
- Select cables for the system with appropriate diameter, heat resistance, and bending resistance.
- Use wires and cables with lengths in the range prescribed in this manual and the instruction manuals for other products used.
- Ensure that the characteristics of other components used in a system match those of the controllers, servo amplifiers, and servomotors.
- Attach covers to prevent servomotor rotating parts being touched during operation.
- The electromagnetic brake may not be able to hold an axis due to age or machine construction (if a servomotor is linked via a timing belt to a ball screw, for example). As a safety measure, provide a stopping device on the machine.

2.2 System Design

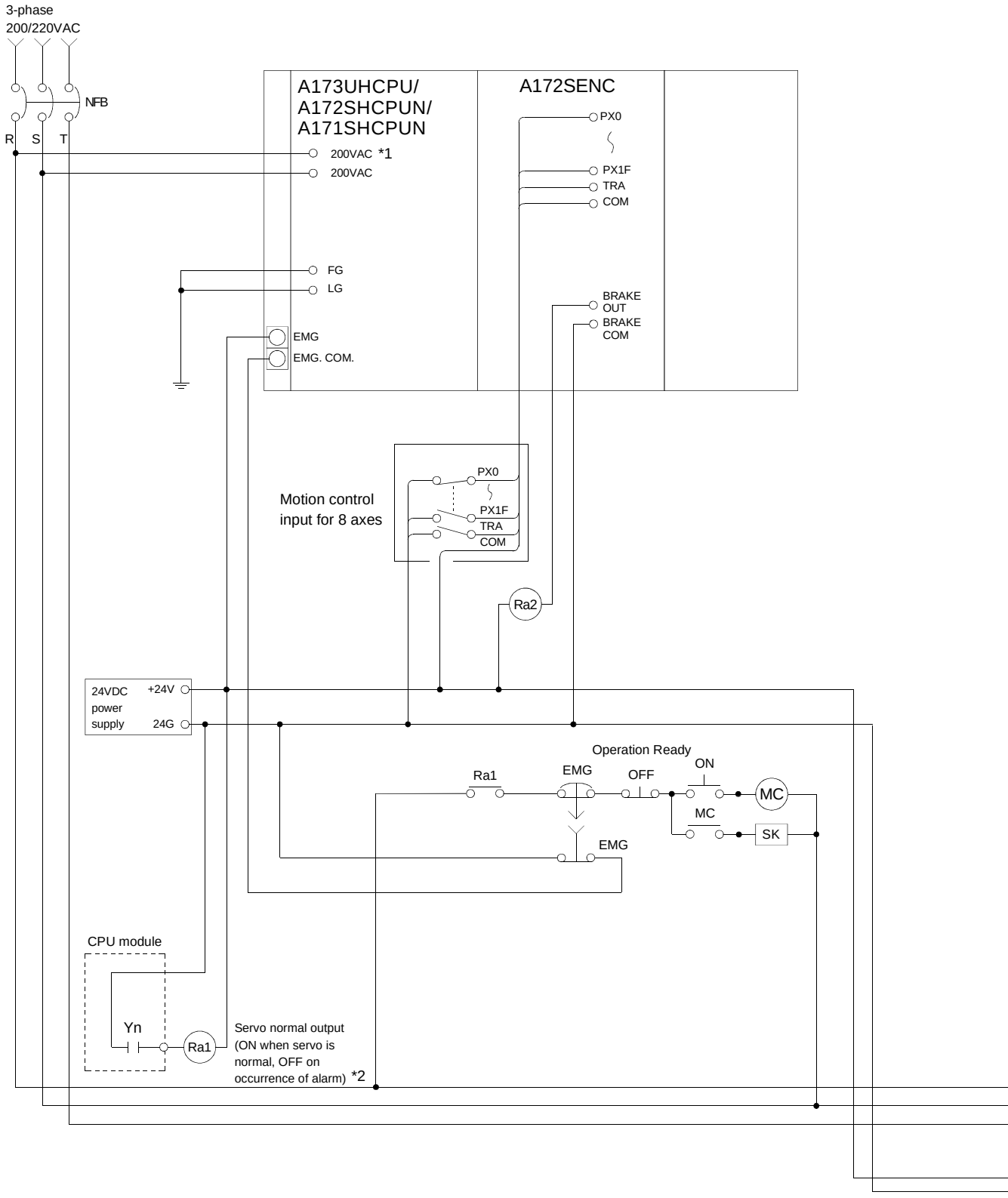
To exercise motion control and external I/O equipment control, the motion system consists of the CPU module, main base unit and various modules such as the power supply module, pulse generator/synchronous encoder modules and I/O modules. Each module must be selected, set, and connected according to the system specifications. Further, the motion system can connect to the graphic operation system (GOT), exercise information control using a personal computer, and connect to a control network which uses the MELSECNET so that the system may be configured up to meet various applications.
Based on the following system configuration, this section explains the ways to select the modules needed in designing the motion system and to set and connect the modules, and the designing precautions.



2.3 External Circuit Design

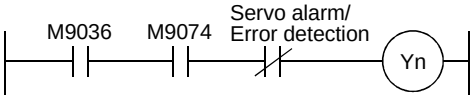
As to the ways to design the external circuits of the motion system, this section explains the method and instructions for designing the power supply and safety circuits, etc.

(1) Sample system circuit design for motion control

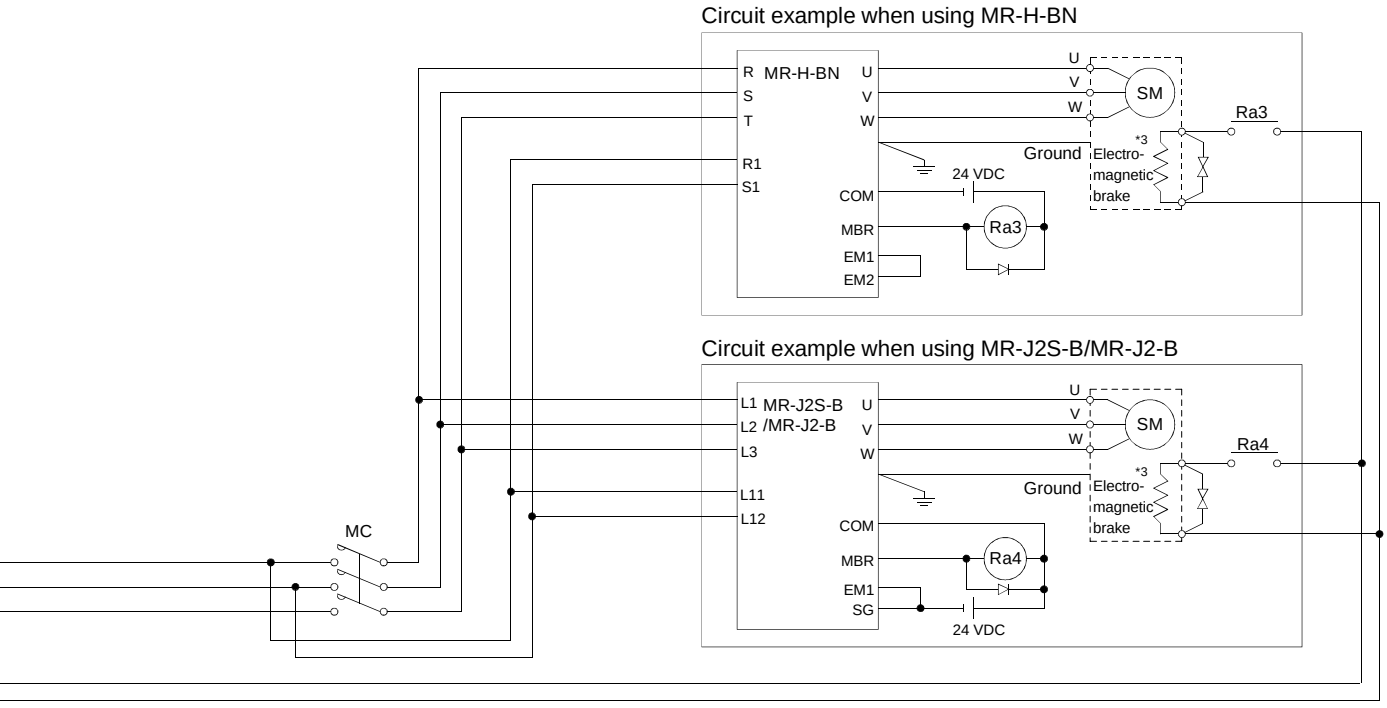


POINTS

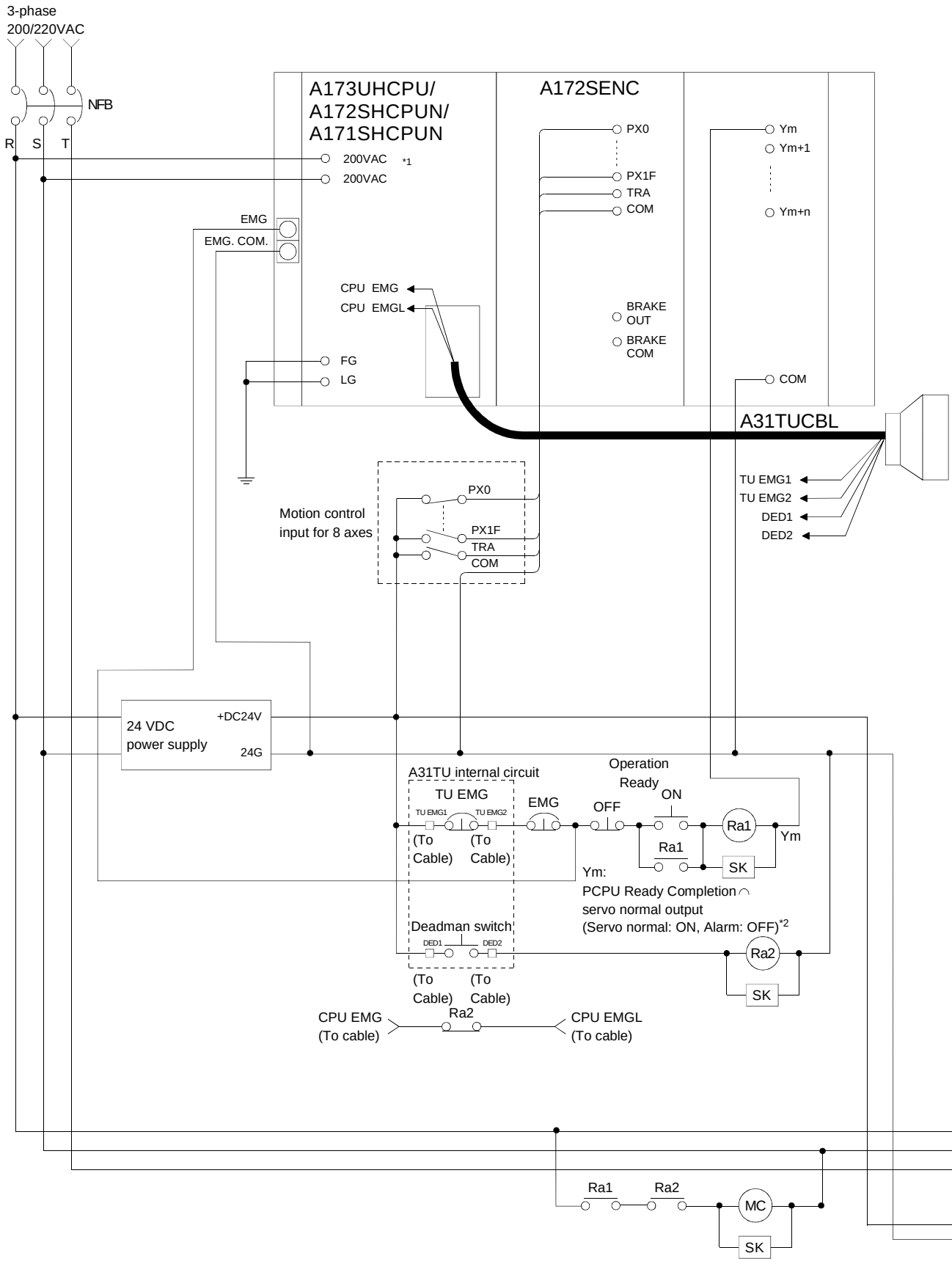
(1) *1 : A 100 VAC power supply can also be used as the power supply to the CPU module.
(2) *2 : Sequence program

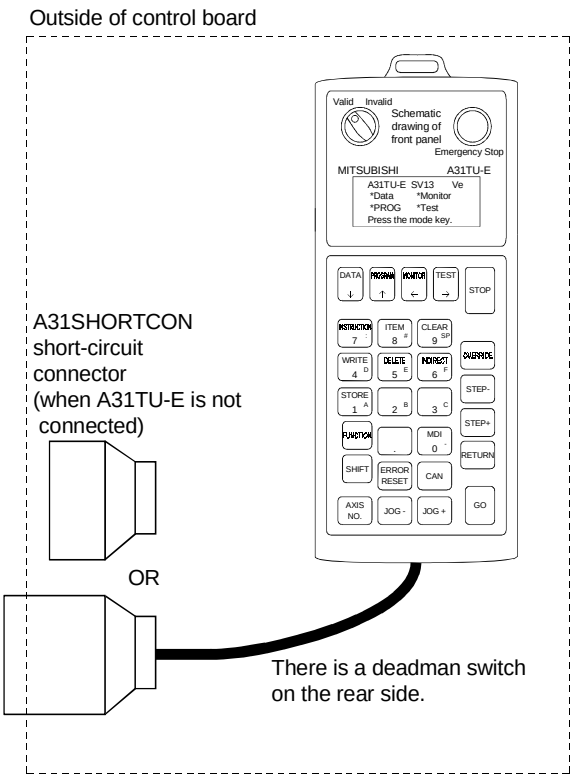


(3) *3 : It is also possible to use a full wave rectified power supply as the power supply for the electromagnetic brake.
(4) For details on connecting SSCNET cables and termination resistors refer to Sections 1.5.6 (2).



(2) Example of system circuit configuration compatible with A31TU-E type teaching unit

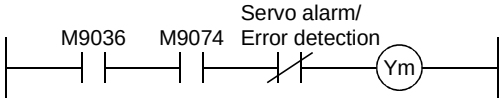




POINT

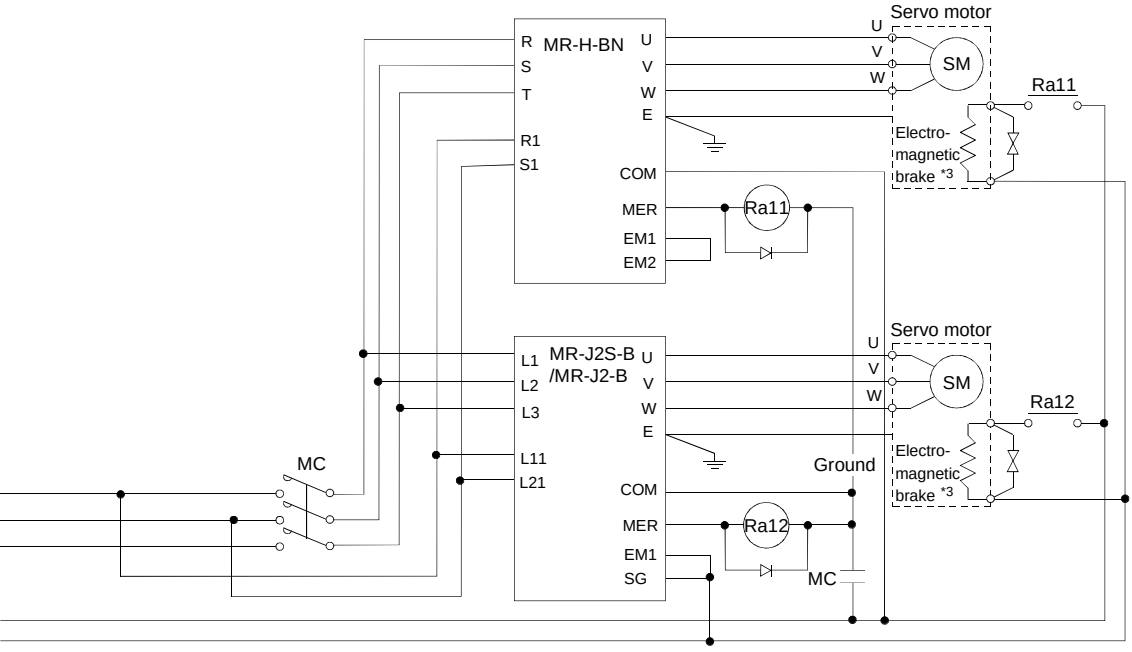
(1) *1 : 100 VAC power supply can also be used as the power supply to the CPU module.

(2) *2 : Sequence program

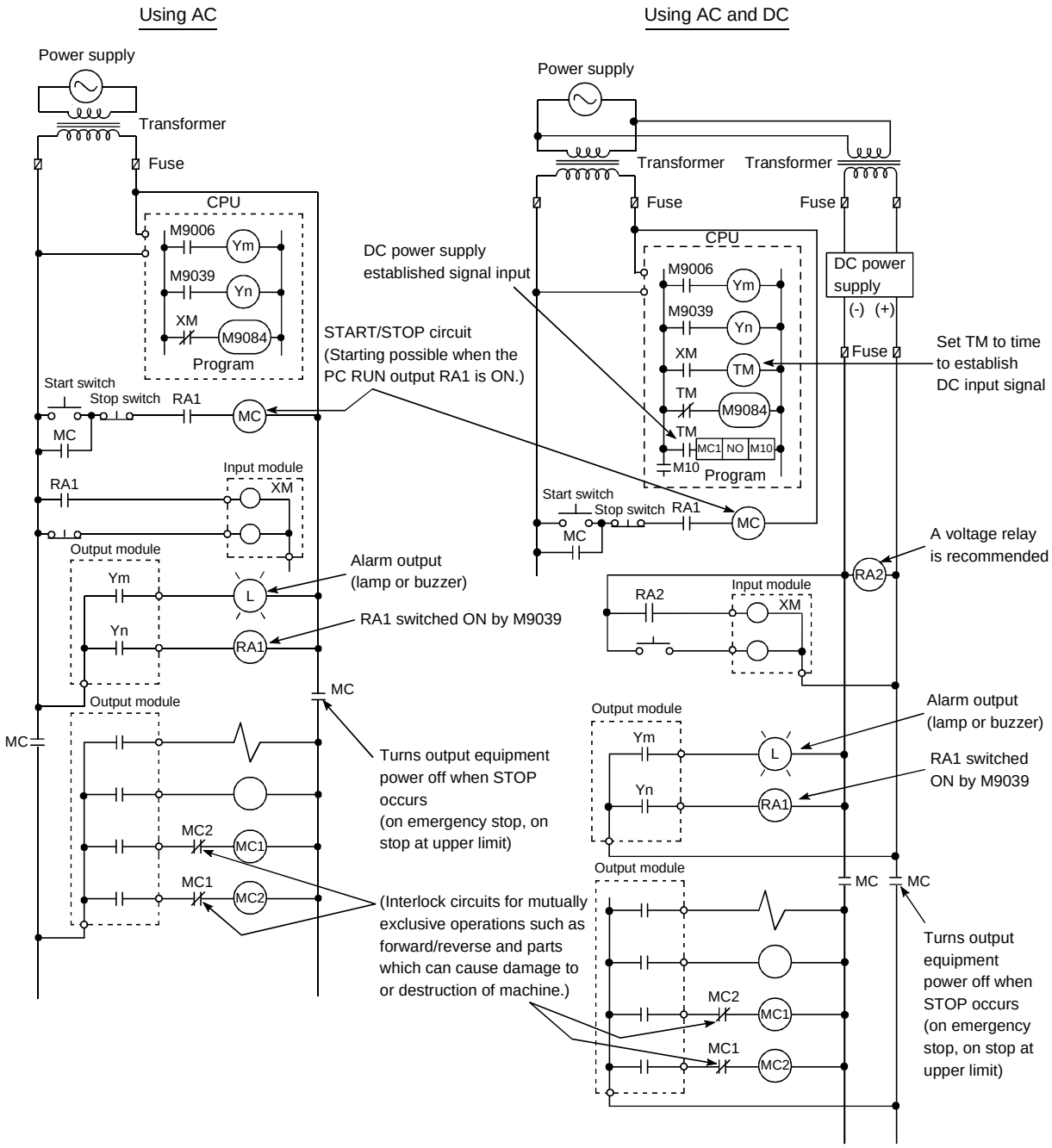


(3) *3 : It is also possible to use a full wave rectified power supply as the power supply for the electromagnetic brake.

(4) For details on connection of SSCNET cable and termination resistors, refer to Section 1.5.6 (2).



(c) Sample system circuit designs



Procedure to start up the power supply.

AC

(1) Set the CPU to RUN.
(2) Turn on the power supply.
(3) Turn on the start switch.
(4) Output equipment driven by program when the electromagnetic contactor (MC) turns on.

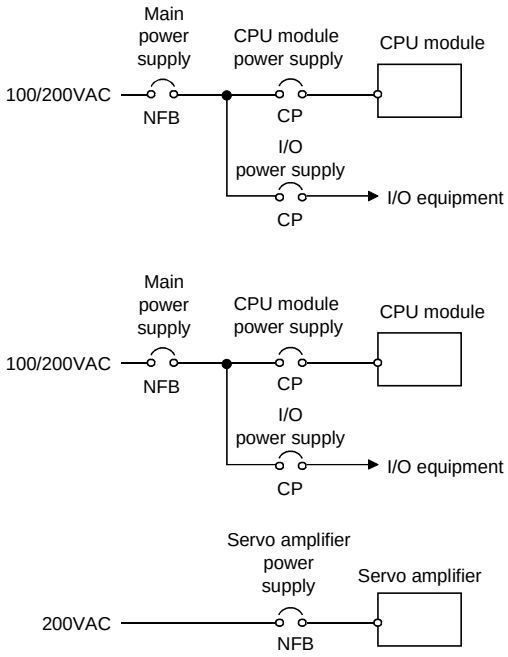
AC and DC

(1) Set the CPU to RUN.
(2) Turn on the power supply.
(3) Turn ON RA2 when DC power supply is established.
(4) Turn on timer (TM) when the DC power supply is 100% established. (Set TM set value to the time from RA2 turning ON until the DC power supply is 100% established. The set time should be approximately 0.5 s.)
(5) Turn on the start switch.
(6) Output equipment driven by program when the electromagnetic contactor (MC) turns on. (When a voltage relay is used as RA2, the timer (TM) in the program is not needed.)

2.3.1 Power Supply Circuit Design

This section describes the protective coordination and noise suppression techniques of the power supply circuit.

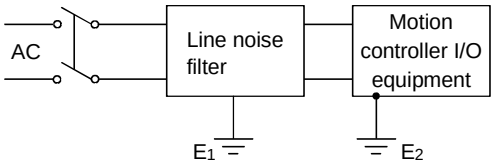
(1) Separation and protective coordination (leakage current protection, overcurrent protection) of power supply lines
When wiring, separate the lines of CPU module power supplies from those of the I/O equipment and servo amplifier as shown below.



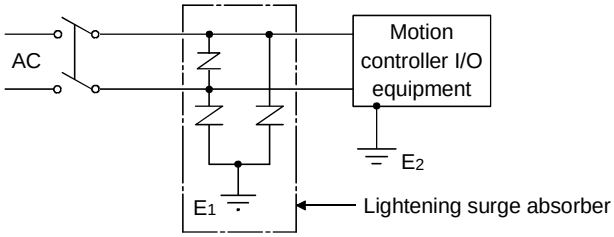
(2) Power supply noise and lightening surge suppression techniques

If there is a possibility that a malfunction may occur due to a sneak noise from the main power supply or servo amplifier or due to a lightening surge, use a line noise filter and lightening surge absorber in the power supply lines of the motion controller and I/O equipment. Also use an insulating transformer for suppression of common noises of the power supplies (noises produced between power supplies and earth).

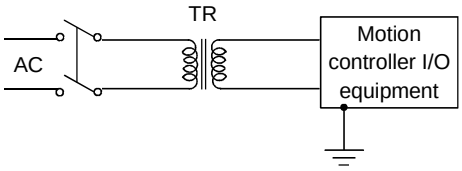
- Example of using the line noise filter



- Example of a circuit using the lightening surge absorber

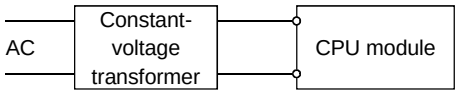


- Example of using the insulating transformer



(3) Circuit designed for voltage fluctuation

If the voltage fluctuation of the main power supply is greater than the specified value, use the constant-voltage transformer.



⚠ CAUTION

⚠ Separate the grounding (E_1) of the line noise filter and lightening surge absorber from the grounding (E_2) of the motion controller.

⚠ Choose the lightening surge absorber which will not cause the maximum permissible circuit voltage of the power supply module to be exceeded when the power supply voltage rises to the maximum.

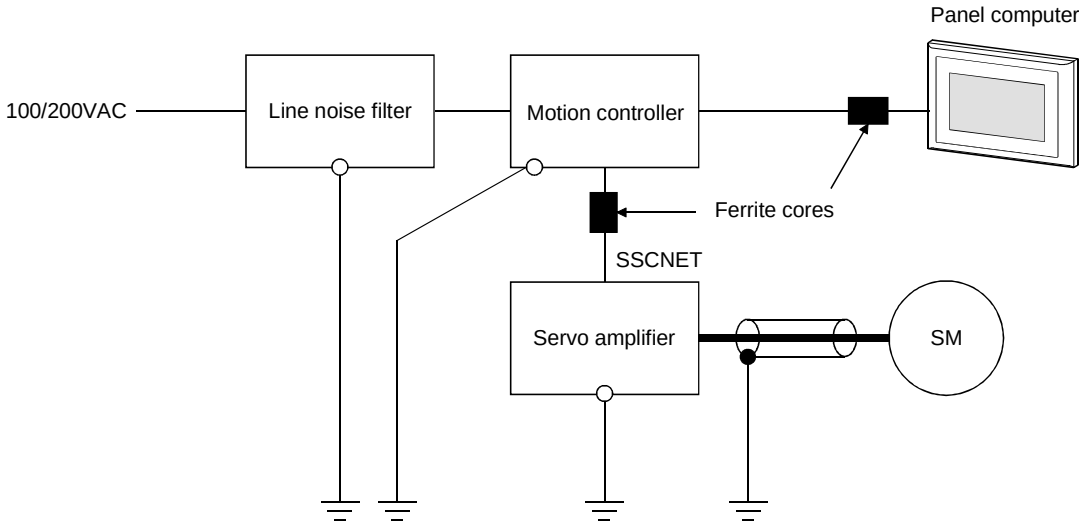
⚠ When using the power transformer which will drop the voltage from 200VAC to 100VAC or the insulating transformer, its capacity should be not lower than the value in the following table.

Power Supply Module Model	Transformer Capacity
A1S61PN	110VA
A1S62PN	110VA
CPU module	110VA

(4) Grounding

The motion system may malfunction as it is affected by various noises such as electric path noises from the power supply lines, radiated and induced noises from other equipment, servo amplifiers and their cables, and electromagnetic noises from conductors. To avoid such troubles, connect the earthing ground of each equipment and the shield grounds of the shielded cables to the earth. Also use ferrite cores to prevent the sneak noises of the SSCNET from entering.

For grounding, use the exclusive ground terminal wire of each equipment or a single-point earth method to avoid grounding by common wiring, where possible, since noises may sneak from other equipment due to common impedances.



2.3.2 Safety Circuit Design

(1) Concept of safety circuits

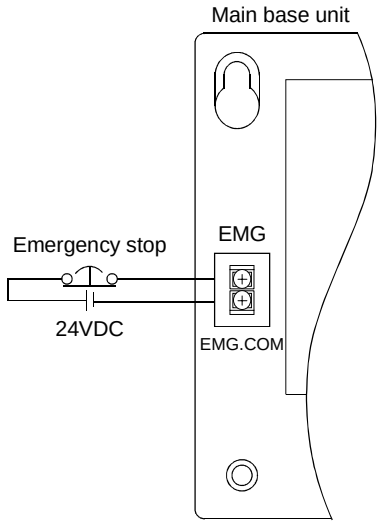
When the motion controller is powered on-off, proper outputs may not be provided temporarily due to the delays and rise times of the motion controller power supply and external I/O control power supplies (especially DC).

For example, if the motion controller is powered on after external process power is switched on in the DC output module, the DC output module may provide a false output instantaneously at power-on of the motion controller. Therefore, the circuit must be made up to enable the motion controller to be powered on first. Also, abnormal operations may be performed when the external power supply becomes faulty or the motion controller fails.

To prevent these abnormal operations from leading to the abnormal operation of the whole system and also from the fail-safe viewpoint, configure up a circuit outside the motion controller for the areas which may lead to machine damage and accidents due to abnormal operations (e.g. emergency stop, protective and interlock circuits).

(2) Main base emergency stop circuit

(a) By opening the EMG circuit of the main base unit, all axes of the external servo amplifiers (MR-H-BN/MR-J2S-B/MR-J2-B) can be brought to an emergency stop at once. After an emergency stop, remove the emergency stop factor and cancel the emergency stop (switch on the EMG circuit) to switch on the servo amplifiers immediately. (An emergency stop does not turn on the servo error detection signal.)
An emergency stop wiring example is shown below.

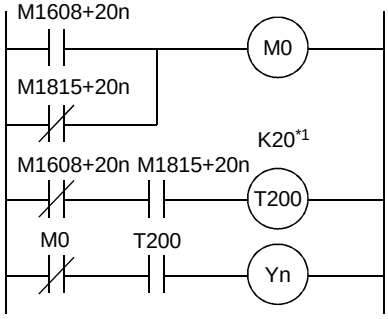


(b) Do not use the emergency stop terminals on the external servo amplifier side.
When the external servo amplifier side requires its own emergency stop circuit, use an external circuit to power off the external servo amplifiers.

(3) External electromagnetic brake circuit

When configuring an electromagnetic circuit externally, create a sequence program to turn off the electromagnetic brake output when the servo error detection or servo OFF command turns off.
Also, write the sequence program to turn on the electromagnetic brake output 200ms after normal detection (servo error detection : OFF and servo OFF command : ON) on the servo side.
Configure the external circuit to open the electromagnetic brake terminal of the servo motor when the electromagnetic brake output turns ON.

- For A172SHCPUN/A171SHCPUN



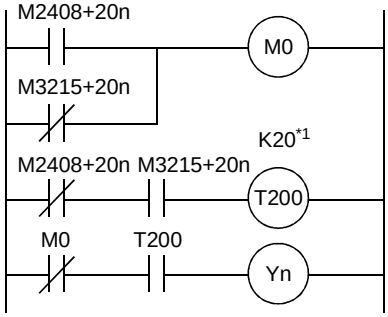
Turns on M0 when servo error detection (M1608+20n) turns on or servo OFF command (M1815+20n) turns off.

Servo error : Turns on T200 200ms
Servo ready : after servo error turns off and servo ready turns on.

Turns on Yn when M0 turns off and T200 turns on.

M1608+20n : Servo error detection
M1815+20n : Servo OFF command
M0 : Servo error or servo ready OFF detection flag
T200 : Servo side normal period (200ms) measuring timer
Yn : Electromagnetic brake operation instruction

- For A173UHCPU



Turns on M0 when servo error detection (M2408+20n) turns on or servo OFF command (M3215+20n) turns off.

Servo error : Turns on T200 200ms
Servo ready : after servo error turns off and servo ready turns on.

Turns on Yn when M0 turns off and T200 turns on.

M2408+20n : Servo error detection
M3215+20n : Servo OFF command
M0 : Servo error or servo ready OFF detection flag
T200 : Servo side normal period (200ms) measuring timer
Yn : Electromagnetic brake operation instruction

POINT

*1 : T200 is a 10ms timer and has an error produced by the scan time of a sequence program, and that error is -2/+1 scan.
Actually open the electromagnetic brake and adjust the setting to avoid a servo side error.

CAUTION

⚠ For details of the electromagnetic brake circuit and amplifier periphery, refer to the manual of the servo amplifier used.

⚠ For vertical lift applications, make up a system which makes a stop using the mechanical locking mechanism which will operate at power-off, emergency stop and alarm occurrence, in addition to the electromagnetic brake, to prevent a drop.

⚠ When you want to make a sudden stop at an emergency stop, use the dynamic brake. If it is used with the electromagnetic brake, the coasting distance will not be so short as expected. When considering double safety, calculate the coasting distance when the dynamic brake fails, and examine whether safety is ensured or not. Refer to Appendix 2 and 3 for the brake characteristics.

(4) Failsafe measures for Motion controller failure

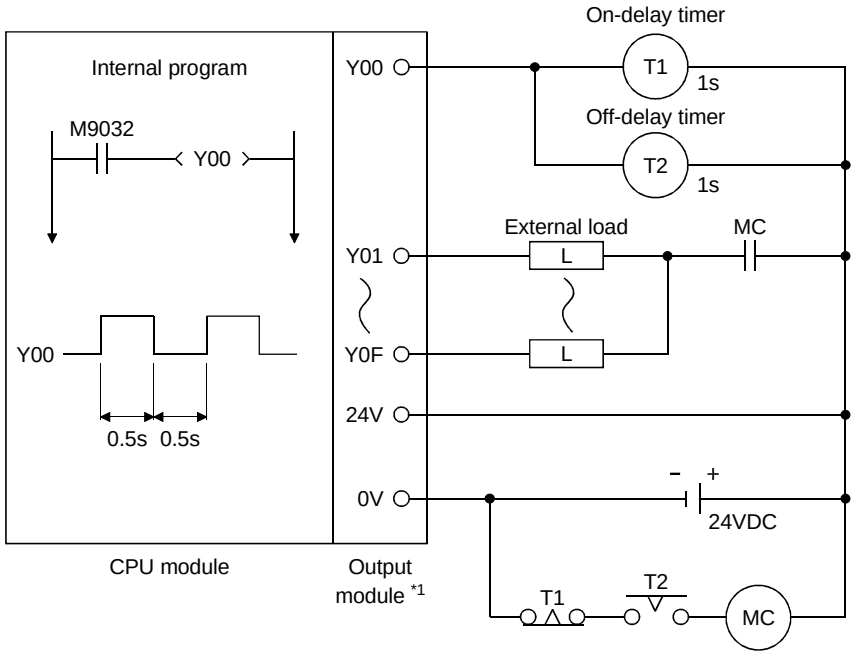
Failure of the CPU module or memory is detected by the self-diagnosis function, but some abnormalities in the I/O control components cannot be detected by the CPU.

Some failures can result in situations such as all points turning on or off, where normal operation and safety of the controlled object cannot be assured.

The manufacturer makes every effort to ensure perfect quality control.

However, external failsafe circuits should be provided to prevent accidents or damage to machines in the event that a failure does occur in the CPU module.

An example of a failsafe circuit is shown in the diagram below.



CAUTION
*1 : Use a non-contact output module for Y00, as it turns ON/OFF at 0.5 s intervals. A transistor is shown in the example above. Using a contact module for Y00 can cause failures.

2.3.3 Instructions for External Circuit Wiring Design

(1) Wiring

(a) Use the wires of the following diameters for wiring.

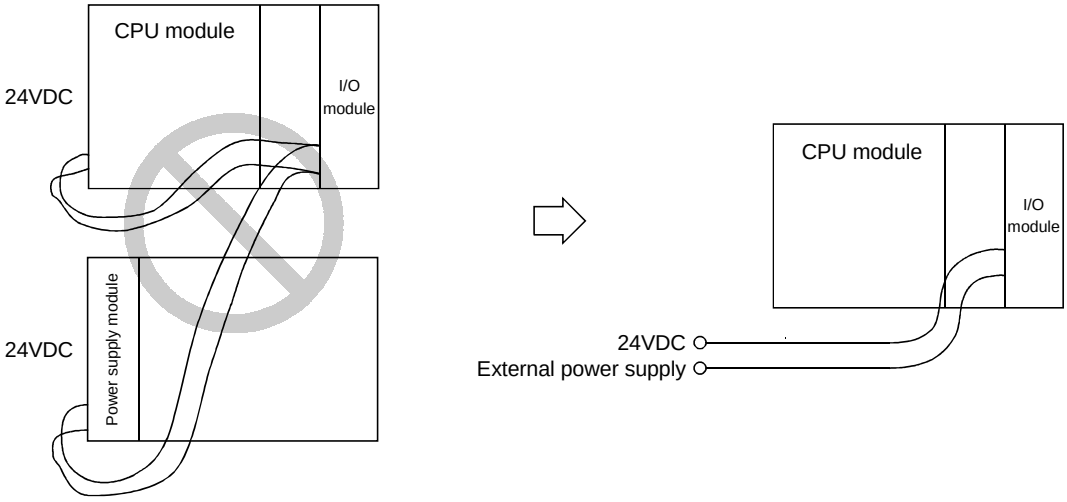
Application	Recommended Wire Diameter
100VAC, 200VAC, 24VDC wires	Thickest possible wires of 2.0mm^2 max.
I/O equipment	0.75mm^2 (0.75 to 1.5mm^2 usable)
Ground wire	2.0mm^2 or more

(b) Twist the 100VAC, 200VAC and 24VDC wires as closely as possible and run them to connect modules in the shortest distance.

(c) Instructions for using the 24VDC output of the A1S62PN power supply module

Do not connect the 24VDC outputs of two or more power supply modules in parallel to supply power to one I/O module. Parallel connection will damage the power supply modules.

If one power supply module cannot provide enough 24VDC output capacity, use an external 24VDC power supply to supply extra power.



CAUTION
Do not connect the 24VDC outputs of two or more power supply modules in parallel to supply power to one I/O module. Doing so can cause burst, damage or the like.
Do not bundle the 100VAC, 200VAC and 24VDC wires with or run them close to the main circuit (high-voltage, large-current) wires and I/O signal wires. Separate them more than 100mm (3.94inch) where possible.

2.4 Layout Design within Enclosure

2.4.1 Location Environment

Avoid locating the motion controller system in environments subject to:
(1) Ambient temperature outside the range 0°C to 55°C
(2) Ambient humidity outside the range 10% to 90% RH
(3) Condensation resulting from sudden temperature changes
(4) Corrosive or inflammable gas
(5) Large amounts of conducting dust or iron filings, oil mist, salt, organic solvents
(6) Direct sunlight
(7) Strong electrical or magnetic fields
(8) Direct vibrations or shocks on the unit.

⚠ CAUTION

⚠ The storage conditions are listed in the table below.

Environment	Conditions
Ambient temperature	0°C to 55°C
Ambient humidity	10% to 90% RH
Atmosphere	No condensation resulting from sudden temperature changes No corrosive or inflammable gas Low levels of conducting dust or iron filings, oil mist, salt, organic solvents Not subject to direct sunlight No strong electrical or magnetic fields No direct vibrations or shocks on the equipment.

2.4.2 Installing the Base Units

This section describes the precautions related to mounting a motion controller in an enclosure.

(1) To improve ventilation and permit easy mounting of the unit, leave a space of at least 30 mm (1.18 inch) between the top of the unit and any other object.

(2) Provide a wiring duct, if required.
Consider the following points if the dimensions from the top or bottom of the motion controller are less than those shown in Fig. 2.1.
(a) If the duct is above the motion controller, limit the duct height to 50 mm (1.97 inch) max. to improve ventilation.
Leave sufficient clearance above the motion controller to allow the mounting screws on top of the unit to be tightened or removed. It is impossible to replace the unit if the screws cannot be removed.

(b) If the duct is below the motion controller, leave sufficient clearance to eliminate effects on the CPU module 100/200 VAC input cables, the I/O module input wires, and 12/24 VDC wires.

⚠ CAUTION
⚠ Due to ventilation problems, do not install the base units vertically or horizontally. ⚠ Install the base units on a flat surface. Unevenness or warping of the surface can apply undue force to printed circuit boards and lead to malfunctions. ⚠ Avoid installing the base units close to a vibration source, such as a large electromagnetic contactor or no-fuse breaker. Mount them on a separate panel or at a safe distance. ⚠ To limit the effects of reflected noise and heat, leave at least 100 mm (3.94 in) clearance to instruments mounted in front of the motion controller (on the rear of the door). Similarly, leave at least 50 mm (1.97 in) clearance between instruments and the left and right sides of the base units.

2.4.3 Installation

The mounting positions of the main base unit and extension base unit are shown below.

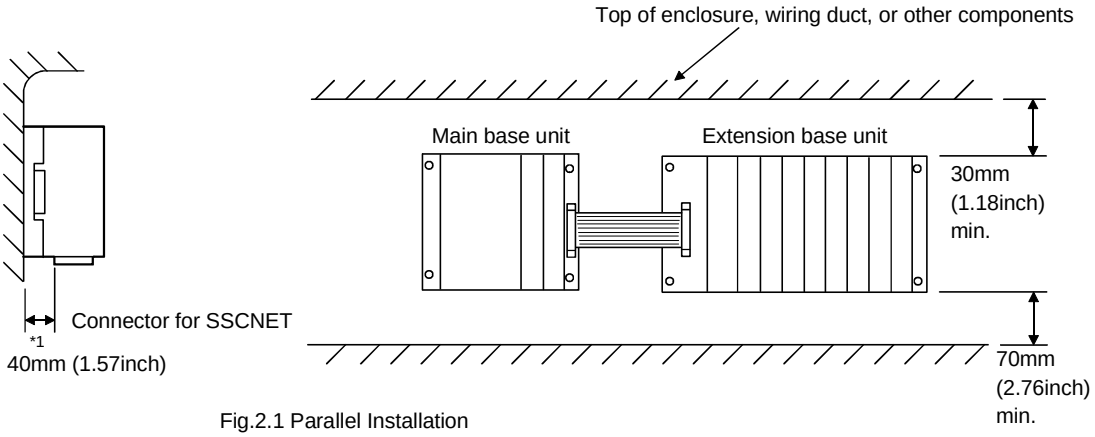


Fig.2.1 Parallel Installation

*1: If a DIN rail is used, consider the mounting position of the DIN rail.

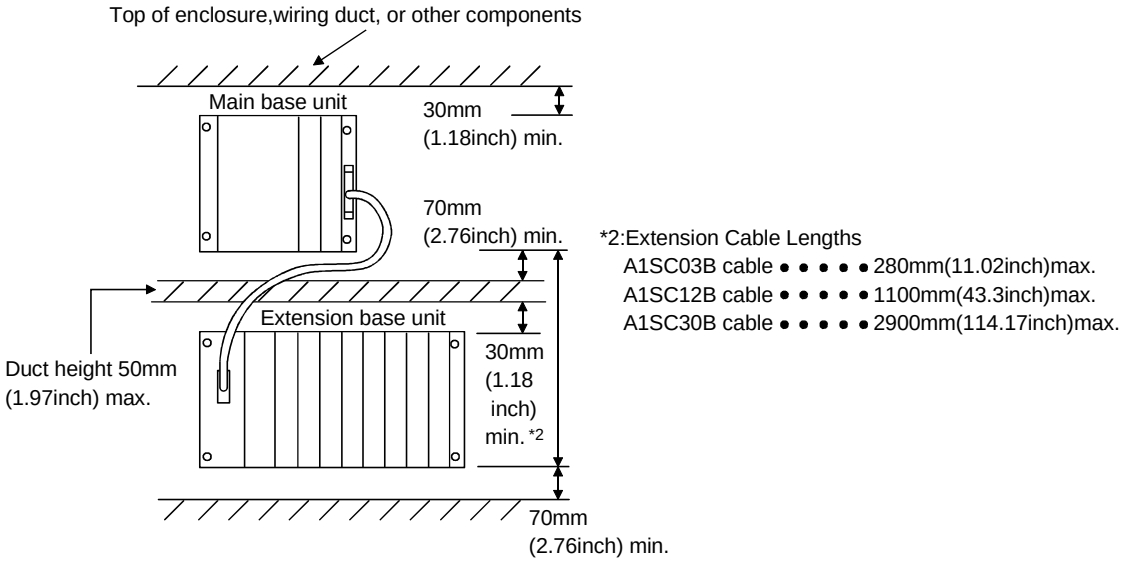


Fig.2.2 Series Installation

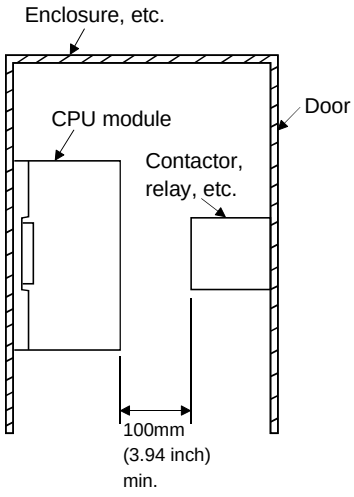


Fig.2.3 Clearance to Instruments in Front of CPU module

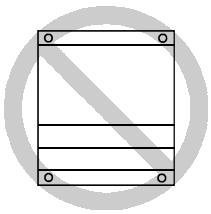


Fig.2.4 Vertical Installation (Not Permitted)

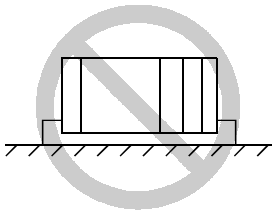


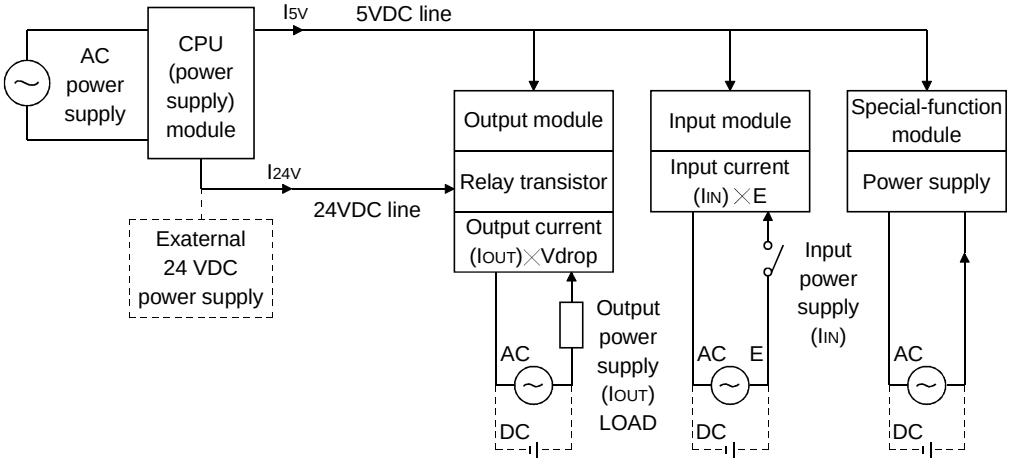
Fig.2.5 Horizontal Installation (Not Permitted)

2.4.4 Calculating Heat Generated by A173UHCPU/A172SHCPUN/A171SHCPUN

If a motion controller is installed in an enclosure, the temperature inside the enclosure must be restricted to the operation ambient temperature of 55°C. The average power consumption (heat generation) of the equipment and instruments in the enclosure must be known to design the heat dissipation of the enclosure.
This section describes how to calculate the motion controller system power losses and average power consumption. Calculate the temperature rise in the enclosure from the power consumption.

Calculating Average Power Consumption

The major motion controller parts consuming power are shown in the block diagram below.



(1) Power consumption of power supply module
The power conversion efficiency of a power supply module is approximately 70%, with the remaining 30% consumed in heat generation.
Therefore, the heat generation is 3/7 of the output power, calculated by the following equation:

$$Wpw = \frac{3}{7}\{(I_{5V} \times 5) + (I_{24V} \times 24)\}(W)$$

I_{5V} : I_{5V} is the current consumption of the 5 VDC logic circuits of each module
I_{24V} : I_{24V} is the 24 VDC average current consumption of the power supply for output module internal consumption
(current consumption of simultaneously ON points)

(2) Total power consumption of 5 VDC logic circuits of all modules
The CPU power supply 5 VDC output circuit power is the total power consumption of each module.

$W_{5V} = I_{5V} \times 5(W)$

(3) Output module average power consumption (power consumption of simultaneously ON points)
The CPU power supply 24 VDC output circuit average power is the total power consumption of each module.

$W_{24V} = I_{24V} \times 24(W)$

(4) Average power consumption from voltage drop in output circuits of the output modules (power consumption of simultaneously ON points)

$W_{OUT} = I_{OUT} \times Vdrop \times$ No. output points $\times$ Simultaneously ON ratio (W)

I_{OUT} : I_{OUT} is the output current(actual operation current) (A)

Vdrop: Vdrop is the voltage drop of each output module (V)

(5) Average power consumption from voltage drop in input circuits of the input modules (power consumption of simultaneously ON points)

$W_{IN} = I_{IN} \times E \times$ No. input points $\times$ Simultaneously ON ratio (W)

I_{IN} : I_{IN} is the input current (effective value for AC) (A)

E : E is the input voltage (actual operation voltage) (V)

(6) Power consumption of special-function module power supply circuits

$W_S = I_{5V} \times 5 + I_{24V} \times 24 \times I_{100V} \times 100$(W)

The total power consumption of each block described above is the power consumption of the entire PC system.

$W = W_{PW} + W_{5V} + W_{24V} + W_{OUT} + W_{IN} + W_S$ (W)

Use the overall calculated power consumption (W) to calculate the heat generation and temperature rise inside the enclosure.
The following equation approximately calculates the temperature rise in the enclosure:

$$T = \frac{W}{UA}(^{\circ}C)$$

W : W is the overall power consumption of the motion controller (calculated above)

A : internal surface area of the enclosure (m^2)

U : if a fan is used to make enclosure temperature uniform 6
if air is not circulated inside the enclosure.....4

⚠ CAUTION
⚠ If the enclosure temperature rises above the prescribed range, a heat exchanger should be attached to the enclosure to lower the temperature. Ventilation of the enclosure with a fan can result in dust problems with the motion controller because of the dust which is introduced with the ambient air.

2.5 Design Checklist

At the worksite, copy the following table for use as a check sheet.

Item	Sub Item	Design Confirmation		Check
Module/unit selection	CPU module selection	Number of axes	axes	☐
		Number of I/O points	points	☐
		Selected CPU module		☐
	Pulse generator/synchronous encoder interface module selection	Manual pulse generator	pcs.	☐
		Synchronous encoder	pcs.	☐
		Number of upper limit points	points	☐
		Number of lower limit points	points	☐
		Number of STOP input points	points	☐
		Near-zero point input	points	☐
		Speed-position change input	points	☐
		Tracking enable signal	points	☐
		Brake unit output	points	☐
		A172SENC	modules	☐
	Limit output module selection	Number of limit output points	points	☐
		A1SY42	modules	
	Teaching unit selection	Use of teaching unit	Yes / No	☐
		Use of deadman switch	Yes / No	☐
		Selected teaching unit		☐
	Main base unit selection	Number of motion modules	modules	☐
		Number of I/O modules loaded to main base	modules	☐
		Selected main base unit		☐
	Sequence extension base unit and extension cable selection	Number of I/O modules loaded to extension base	modules	☐
		Distance between main base and extension base	mm	☐
		Selected extension base unit		☐
		Selected extension cable		☐
	Extension base power supply module selection	Total of currents consumed by modules loaded to extension base	A	☐
		Current consumption of 24VDC supplied by extension power supply	A	☐
		Selected extension power supply module		☐
External circuit design	Fail-safe circuit design	Avoidance of malfunction at power-on		☐
		Avoidance of hazard at motion controller failure		☐
		Safety circuit for use of teaching unit with deadman switch		☐
		Safety circuit of motor equipped with electromagnetic brake		☐
Layout design	Module layout design	Conformance with general specifications such as ambient temperature, humidity, dust, dirt, etc.		☐
		Layout in consideration of clearances between enclosure's inside walls, other structures and modules and heats generated by modules inside enclosure		☐

3. MOUNTING AND WIRING

This chapter provides the mounting and wiring procedures and hardware handling information for those who will mount each equipment to a control box or the like, design wiring and install the hardware.
This chapter does not give the ways to install and wire the amplifiers, motors and others and the way to wire the external relay circuit. Refer to the corresponding manuals.

3.1 Mounting and Wiring Methods

Item	Sub Item	Mounting/Wiring Outline	Refer To
Unit/module mounting	Base unit mounting	Mounting of base unit to enclosure ● Mounting without DIN rail ● Mounting with DIN rail	Section 3.2
	Mounting of modules to base unit	Mount the CPU, power supply, I/O, special function, motion and other modules to the base unit.	Section 3.3
	Synchronous encoder mounting	Mounting of serial synchronous encoder to machine side rotary shaft	Section 3.4
Wiring	Running of power supply and I/O wires	Running of power supply and I/O wires of power supply and I/O modules	Section 3.5

3.2 Mounting the Base Unit

This section provides the way to mount the main or extension base unit to an enclosure or the like.
Place the base unit according to the precautions for base unit layout design in Section 2.4.2.

⚠ CAUTION

- ⚠ The terminal block and pin connectors of this base unit are made of resin. Do not drop them or give them hard impact.
- ⚠ Do not remove the printed circuit boards of the base unit. Doing so can cause a failure.
- ⚠ Wire the cables carefully to ensure that no foreign matter such as wire-offcuts enter the base unit. Remove them if any.
- ⚠ Tighten the base unit mounting screws within the tightening torque range.
- ⚠ While power is on, do not install or remove the base unit.
- ⚠ While power is on, do not mount or dismount the modules to or from the base unit.
- ⚠ Install the base unit in a weight-bearing place according to this manual.
- ⚠ Do not stand or rest heavy objects on the product.
- ⚠ Always check that the mounting orientation is correct.

3.2.1 Mounting without DIN Rail

Drill mounting screw holes in accordance with the outline dimensional drawings in Appendix 1.3 Main Base Unit and Appendix 1.4 Extension Base Unit.

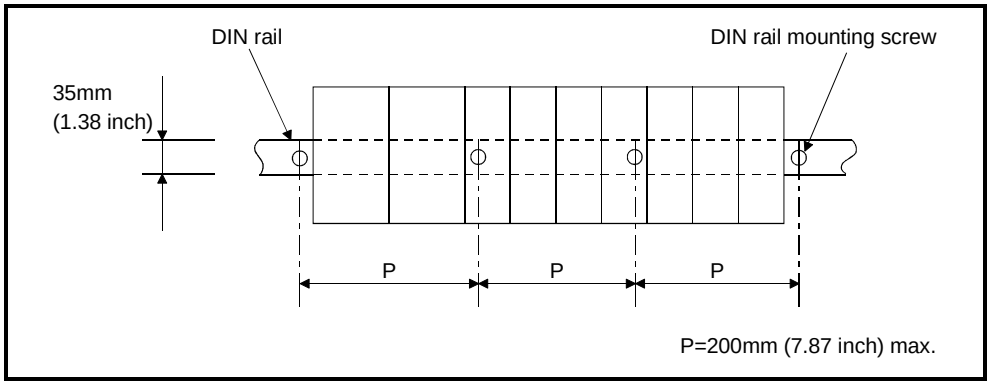
Screw	Tightening Torque Range N ● cm
Base mounting screw (M5 screw)	273 to 361 (Control box, when screws are made of iron)

3.2.2 Mounting with DIN Rail

The main base unit and extension base unit are fitted with DIN rail mounting hooks as standard.
This section describes the method for mounting the DIN rail.

(1) Applicable DIN rail models (JIS-C2B12)
TH35-7.5Fe
TH35-7.5AI
TH35-15Fe

(2) Spacing of DIN rail mounting screws
If a TH35-7.5Fe or TH35-7.5AI DIN rail is used, insert screws at a pitch of 200 mm (7.87 inch) max. to reinforce the rail mounting.

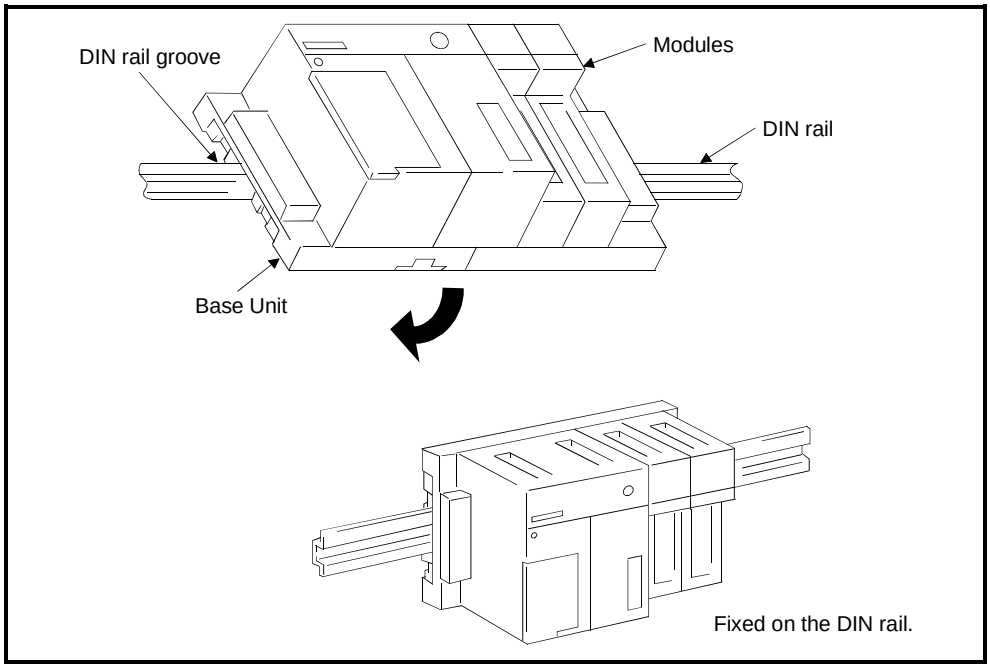


(3) Mounting units to, and removing them from, the DIN rail

(a) Mounting to DIN rail

The procedure to mount a base unit on the DIN rail is described below.

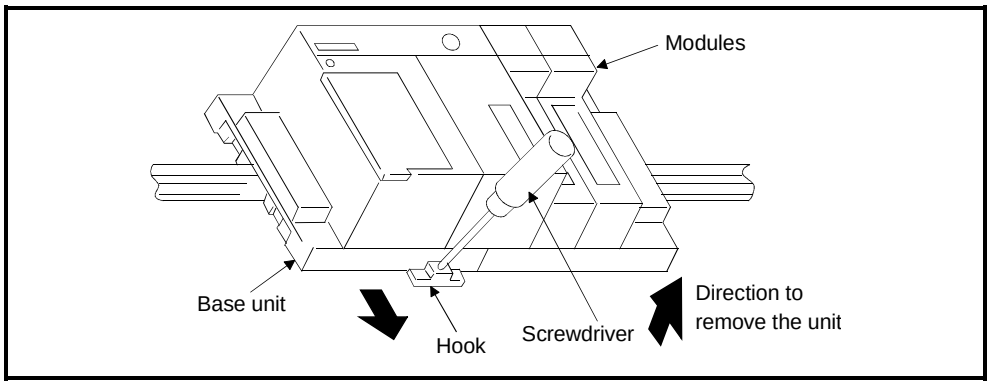
1) Engage the top of the base unit DIN rail groove with the top of the DIN rail.
2) Push the base unit toward the DIN rail to fasten it.



(b) Removing from DIN rail

The procedure to remove a base unit from the DIN rail is described below.

1) Use a flat screwdriver to push down the hook under the base unit.
2) Pull the unit forward while pushing the hook down to remove the unit from the DIN rail.

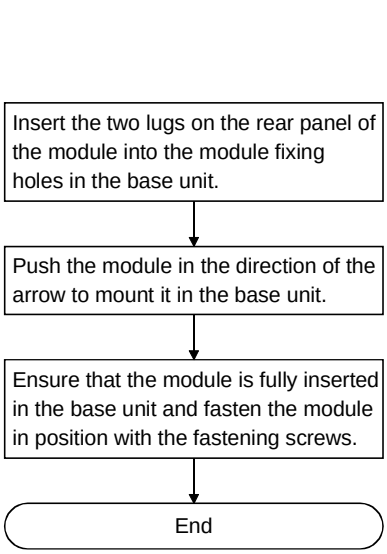


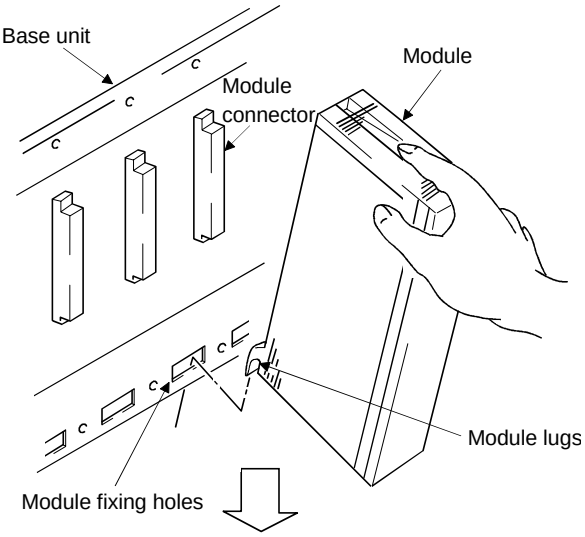
3.3 Mounting and Removing Modules

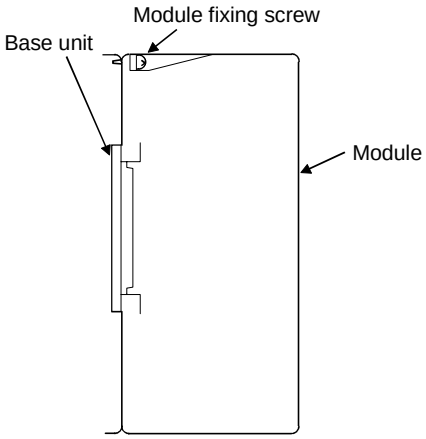
This section describes how to mount CPU modules, I/O modules, and special-function modules in a base unit, and how to remove them.

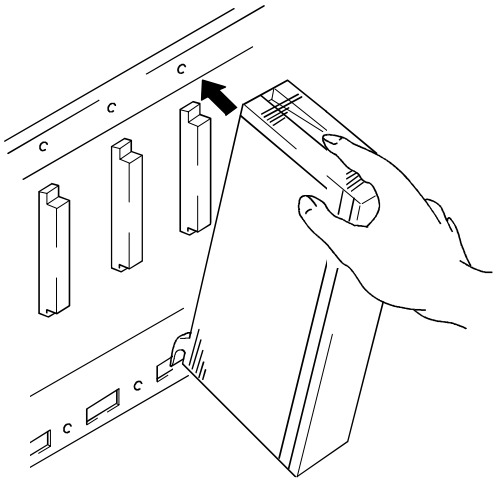
(1) Mounting modules

Follow the procedure below to mount a module in the base unit.









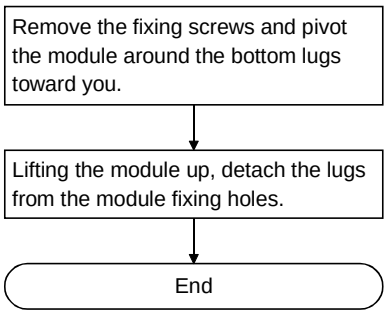
⚠ CAUTION

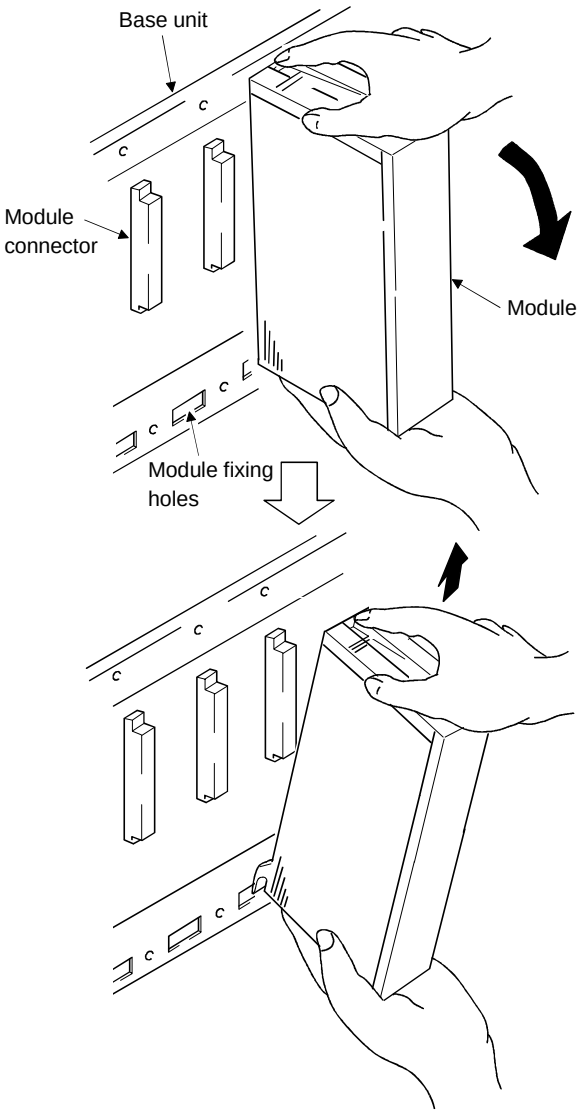
⚠ The lugs must be inserted in the module fixing holes when the module fixing screws are inserted. Forcibly fixing a module in place without inserting the lugs in the holes will bend the module connector pins and cause other damage.

⚠ Turn off the power supply before mounting or removing a module.

(2) Removing modules

Follow the procedure below to remove a module from the base unit.





(3) Fixing modules

When fixing the modules to the base unit, tighten the screws within the following range.

Screw	Tightening Torque Range N ● cm
Module mounting screw (M4 screw)	78 to 117

⚠ CAUTION
⚠ When removing a module, remove the module fixing screws before attempting to remove the lugs from module fixing holes. Forcing out a module may damage the lugs. ⚠ Turn off the power supply before mounting or removing a module. ⚠ The terminal block and pin connectors of this base unit are made of resin. Do not drop them or give them hard impact. ⚠ Do not remove the printed circuit boards of each module. Doing so can cause a failure. ⚠ Wire the cables carefully to ensure that no foreign matter such as wire-offcuts enter from the module top. Remove them if any. ⚠ Tighten the module mounting and emergency stop input terminal screws within the tightening torque ranges. ⚠ When fitting the module to the base, press the module against the base to ensure that the latch is locked into the base. When removing the module, push the latch until the latch comes out of the base completely, and pull the module toward you.

3.4 Mounting the Serial Absolute Synchronous Encoder

Precautions when using a MR-HENC serial absolute synchronous encoder.

(1) If the serial absolute synchronous encoder is linked to a chain, timing belt, or gears, the machine rotating shaft should be supported by a separate bearing and connected to MR-HENC through a coupling. Ensure that excessive force (greater than the permitted shaft load) is not applied to the encoder.

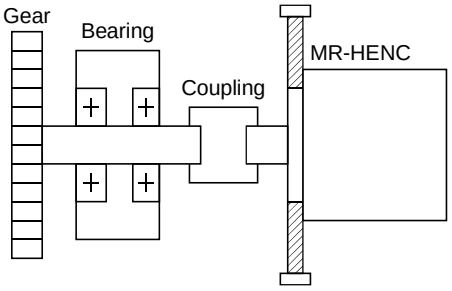


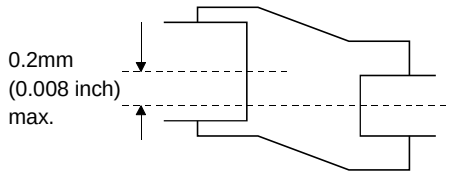
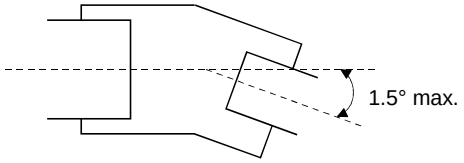
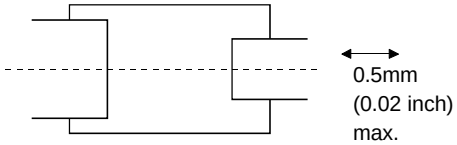
Fig. 3.1 Example of Encoder Linked to a Gear

Table 3.1 Permitted Shaft Loads

	Radial Direction	Thrust Direction
Permitted shaft load	98N max.	49N max.

(2) Large errors in eccentricity and angle of deviation during mounting can apply an excessive force to the MR-HENC shaft, which can cause deterioration in performance drastically reduce encoder life.
Minimize loads applied to the shaft such that they lie within the permitted shaft load range. The permitted shaft loads are shown in Fig. 3.2 for the recommended coupling type.

Table 3.2 Permitted Values for Coupling Mounting Errors

Eccentricity	
Angle of deviation	
Axial displacement	

⚠ CAUTION

⚠ The MR-HENC contains a glass disk and precision mechanism. Take care when handling it. The encoder performance may deteriorate if it is dropped or subjected to shocks or vibration exceeding the prescribed limits.

⚠ Do not connect the encoder directly to the rotating machine shaft. Always connect the encoder through a flexible coupling.

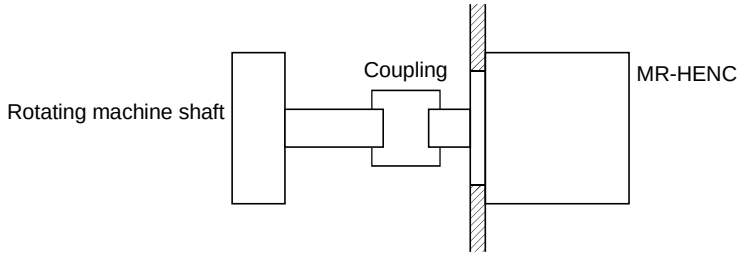


Fig. 3.2 Connecting the Encoder to a Machine Shaft

⚠ Never hit the end of the MR-HENC coupling shaft with a hammer when connecting the coupling to it.
The large loads applied to MR-HENC will damage it.

⚠ The MR-HENC uses optical parts. Install it in an atmosphere where there are extremely few water drops and little oil and dust.

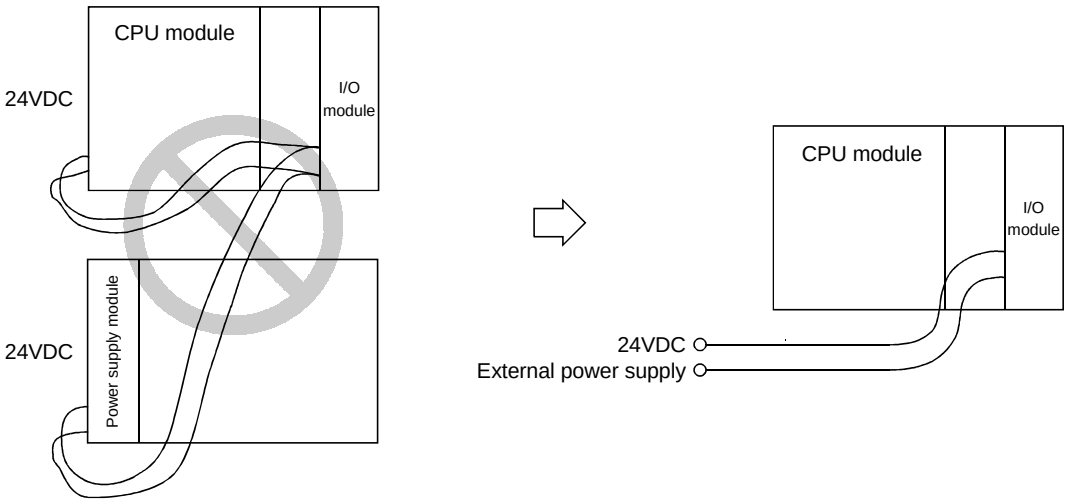
⚠ In any place where the MR-HENC is exposed to water and/or oil, provide protection from oil and water, e.g. install a cover. In addition, run the cable downward to prevent oil and/or water from running on the cable into the MR-HENC. When it is inevitable to mount the MR-HENC vertically or obliquely, trap the cable.

⚠ Use the MR-HENC within the specified temperature range (0°C to 55°C).

3.5 Wiring

3.5.1 How to Run the Power Supply and I/O Wires

(1) Precautions when using the A1S62PN power supply module 24 VDC output
Do not connect 24 VDC outputs from multiple power supply modules in parallel to supply a single I/O module. The power supply modules will be damaged if the outputs are connected in parallel. If the 24 VDC output capacity of a single power supply module is insufficient, supply power from an external 24 VDC power supply.



(2) Twist 100 VAC, 200 VAC, and 24 VDC wires together as tightly as possible. Connect units together over the minimum distance.

(3) To minimize the voltage drop, use the thickest 100 VAC, 200 VAC, and 24 VDC wires possible (2 mm^2 max.).

(4) Wiring the I/O equipment
(a) Wires between 0.75 mm^2 and 1.5 mm^2 can be connected to the terminal block, but 0.75 mm^2 wires are recommended.

(b) If wires pass through a conduit, the conduit must be grounded.

CAUTION

- Do not connect 24 VDC outputs from multiple power supply modules in parallel to supply a single I/O module. This can damage or destroy the power supply modules.
- Do not position the 100 VAC, 200 VAC or 24 VDC cables close to, or bundle them with, power-circuit (high-voltage, high-current) cables or I/O signal cables. A clearance of at least 100 mm (3.94 in) to other cables is required.

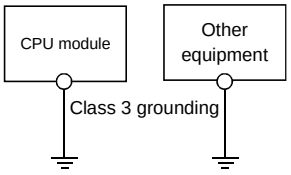
(c) Keep 24 VDC I/O wires separatlf wires from 100 VAC and 200 VAC wires.

(5) Grounding

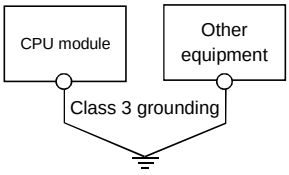
Connect the ground wiring as described in steps (a) to (c) below.

(a) Use a separate ground, if possible. Ground resistance 100Ω or less. (class 3 grounding)

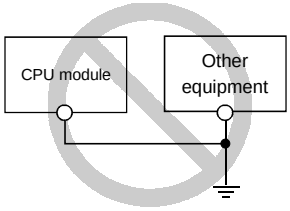
(b) If a separate ground is not possible, connect to ground as shown in (2) below.



(1) Separate ground connections ..... optimum



(2) Common ground connection ..... acceptable



(3) Common ground connection ..... not permitted

(c) Grounding cables to be 2 mm^2 min.

Grounding point to be as close as possible to the A173UHCPU/A172SHCPUN/A171SHCPUN and the distance to the grounding point as short as possible.

(6) Module terminal block wiring screws

Tighten the wiring screws of the module terminal block within the following range.

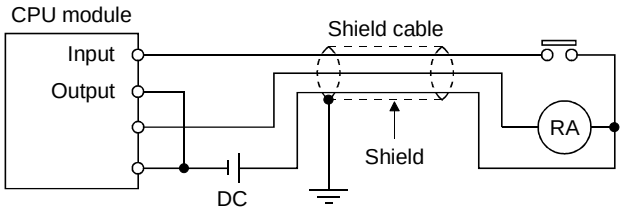
Screw	Tightening Torque Range N ● cm
Terminal block and terminal screws (M3.5 screws)	59 to 88

⚠ CAUTION

⚠ Connect input and output wires along different routes.

⚠ Leave at least 200 mm (7.87 in) clearance between I/O wires and high-voltage, high-current main-circuit cables.

⚠ If the I/O wires cannot be kept separate from the main-circuit or power cables, use shielded cable for all of them and ground the shield at the CPU module end. However, if appropriate, ground the other end of the shield



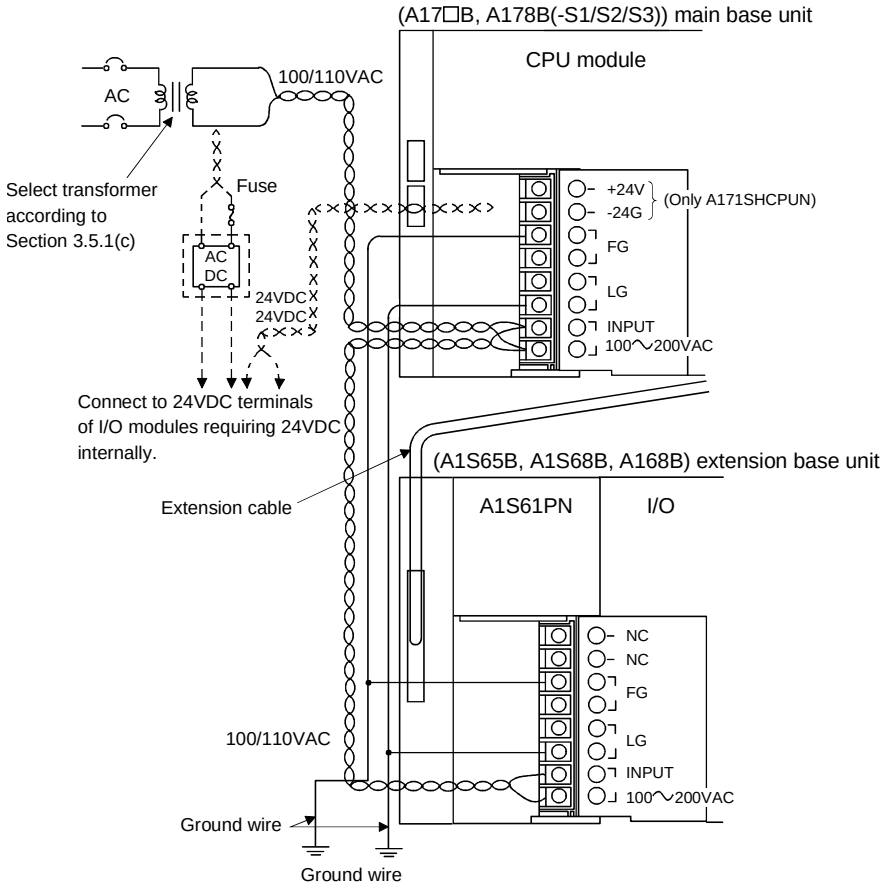
⚠ Keep 24 VDC I/O wires separate from 100 VAC and 200 VAC wires.

⚠ The leakage current over long-distance wiring connections exceeding 200 m (656.17 ft.) can lead to problems.
See Section 5.4.2 (9) for appropriate countermeasures.

⚠ Ground resistance to be 100Ω max (class 3 grounding). Do not share a common ground with other equipment.

3.5.2 Example of Routing the Power Supply and I/O Wires

This section shows examples of wiring the main base unit and extension base unit power-supply and ground wires.



POINTS
(1) Use wires as thick as possible (2 mm^2 max.) for the 100 VAC, 200 VAC, 24 VDC wires. Twist the wires when connected to the terminals. Use solderless terminals with insulating tubes to prevent shorting if the screw in the solderless terminal is loose. (2) Grounding is required if the FG and LG terminals are connected or resistance to noise is reduced. A shock may be felt when touching the LG terminal as it has a potential of 1/2 input voltage.

3.6 Mounting/Wiring Checklist

At the worksite, copy the following table for use as a check sheet.

Item	Sub Item	Mounting/Wiring Confirmation	Check
Unit/module mounting	Base unit mounting	Check for loose or distorted mounting.	☐
		Check that the mounting screw tightening torque is as specified.	☐
		Check the unit for damage.	☐
	Mounting of modules to base unit	Check that the mounted module models are correct.	☐
		Check that the A172SENC and A1SY42 are mounted to the motion slots.	☐
		Check for loose or distorted mounting.	☐
		Check that the mounting screw tightening torque is as specified.	☐
		Check the modules for damage.	☐
	Synchronous encoder mounting	Check that the amplitude, eccentricity and axial displacement relative to the machine side rotary shaft are within the permissible values.	☐
		Check that a flexible coupling is used for coupling with the machine side rotary shaft.	☐
		Check the module for damage.	☐
		Check that excessive impact was not given during mounting.	☐
Wiring	Running of power supply and I/O wires	Check that the 100VAC, 200VAC and 24VDC wires are twisted as closely as possible and run in the shortest distance.	☐
		Check that the 100VAC, 200VAC and 24VDC wires are not bundled with and run close to the power and I/O wires.	☐
		Check that each wiring is of the specified wire size.	☐
		Check for loose terminal block screws.	☐
		Check that the terminal block screw tightening torque is as specified.	☐
		Check that LG and FG are class 3-grounded.	☐

4. TRIAL RUN AND ADJUSTMENT

This chapter describes the checking items and procedures necessary for trial run and adjustment for those who will perform trial run and adjustment of the motion system.

4.1 Checklist before Trial Operation

Table 4.1 Checklist before Trial Operation

Model Name	Check Item	Reference
CPU module	(1) Is memory protection switch ON?	1.5.1 (5)
	(2) Is the memory cassette battery (A6BAT) lead connector fully inserted into the PCB pin connector.	1.5.7
	(3) Is the battery voltage normal? (Nominal value: 3.6 V)	
	(4) Are the supply voltage and power supply module rated voltage correct?	1.5.2
	(5) Are FG and LG wired correctly?	3.5.2
	(6) Are terminal screws correctly tightened?	3.5.1 (6)
	(7) Are cable sizes correct?	3.5.1
A172SENC manual pulse generator/ synchronous encoder interface module	(1) Is the module mounted in the correct position (option slot)?	1.5.4 (3) (a)
	(2) Is the interface with external equipment correct?	1.5.4 (3) (b) 1.5.4 (3) (c)
Main base unit	(1) Are the mounted module models correct?	1.5.3 (3)
	(2) Is the mounting order correct?	
	(3) Are the modules correctly mounted?	3.3
Extension base power supply module	(1) Is the correct power module model mounted?	1.5.2 (2)
	(2) Are FG and LG wired correctly?	3.5.2
	(3) Are terminal screws correctly tightened?	3.5.1 (6)
	(4) Are cable sizes correct?	3.5.1
I/O module	(1) Do cables connected to each terminal of the terminal block match the signal names?	A1SCPU User's Manual
	(2) Are terminal screws correctly tightened?	
	(3) Are cable sizes correct?	
	(4) Is the external power supply correctly connected? (24 VDC, 5 VDC)	
Special-function module	(1) Are the setting switches correctly set?	
	(2) Do cables connected to each terminal of the terminal block match the signal names?	
	(3) Are terminal screws correctly tightened?	
	(4) Are cable sizes correct?	
	(5) Is the external power supply correctly connected? (24 VDC, 5 VDC)	
A1SG62 dummy module	(1) Is the point-setting switch correctly set?	
Extension base unit	(1) Is the extension base unit model correct (A1S65B or A1S68B or A168B)?	1.5.3
	(2) Are the mounted module models correct?	1.5.3 (3)
	(3) Check that the total I/O module and special-function module I/O points does not exceed the number of CPU module I/O points.	1.5.1
	(4) Are the modules correctly mounted?	3.3
Extension cable	(1) Is the extension cable connector correctly inserted in base unit connector?	1.5.3
	(2) Is the extension cable connector position correct?	
	(3) Does the total length of the extension cables exceed 3 m (118.11 inch)?	—

4. TRIAL RUN AND ADJUSTMENT

CAUTION

- Check and adjust the programs and parameters before starting trial operation. Errors in the programs or parameters may cause the machine to make unpredicted movements.
- Never make very large adjustments as this can make operation unstable.

WARNING

- Do not open the front casing or terminal cover during operation or when power is connected. This can cause electric shocks.
- Do not operate with the front case or terminal cover open. This can cause electric shocks from exposed high-Voltage terminals or charged parts.
- Do not operate switches when your hands are wet. This can cause electric shocks.
- Do not scratch, apply undue strain to, place heavy weights on, or trap, cables. This can cause electric shocks.
- Do not touch controller, servo-amplifier, or servomotor terminal blocks while power is turned on. This can cause electric shocks.
- Do not touch the controller or servo amplifier internal power supply, internal ground, or signal wires. This can cause electric shocks.

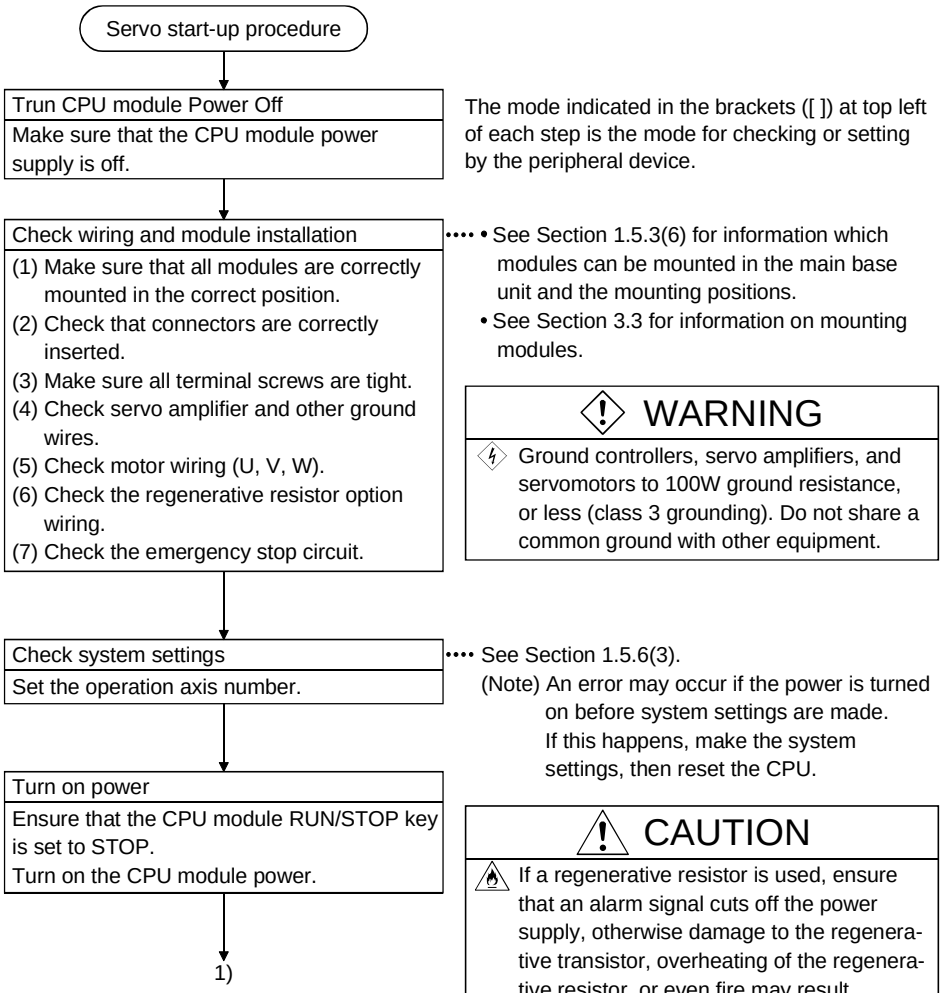
CAUTION

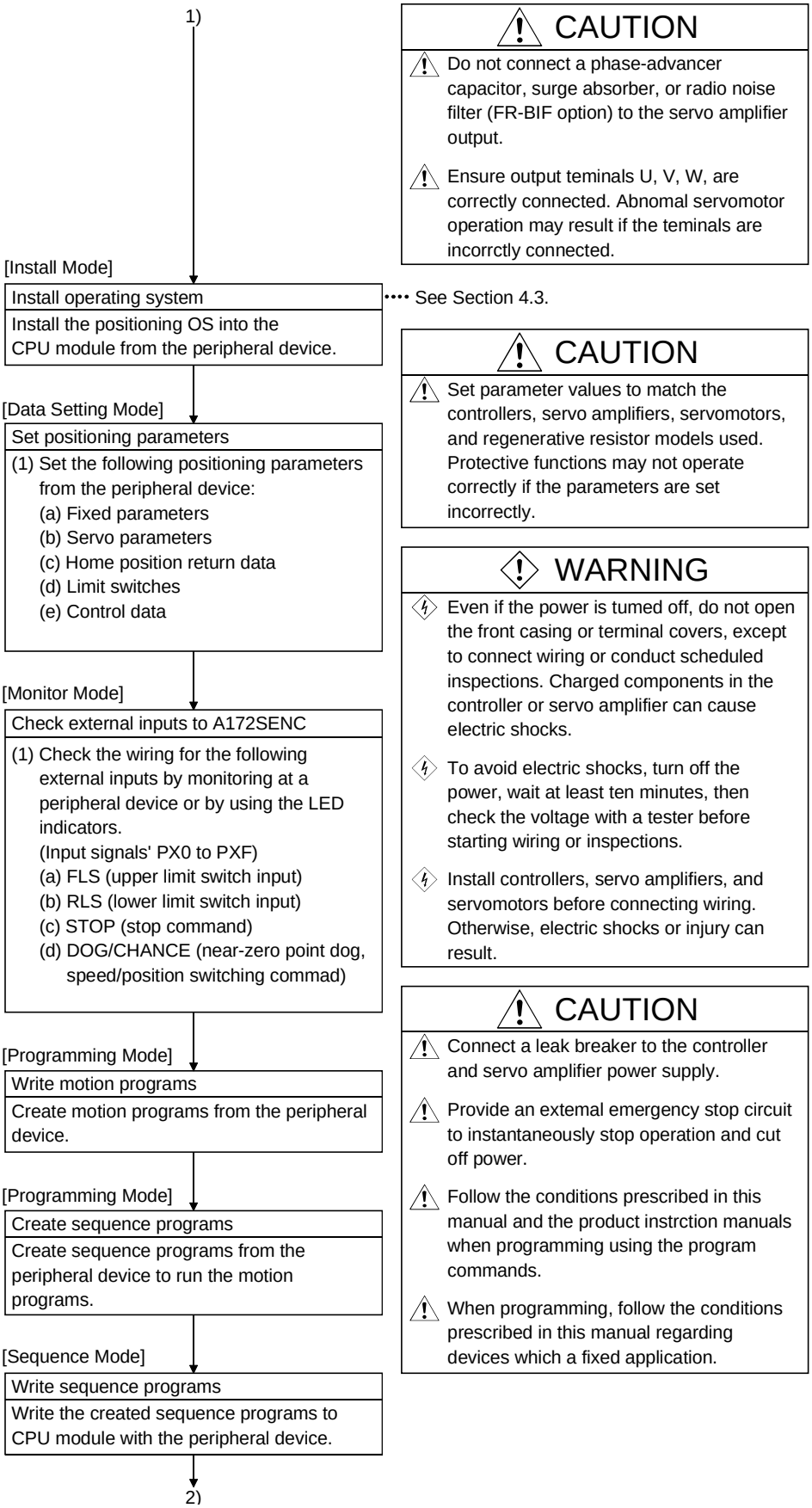
- The machine may make unpredicted movements after a servo amplifier or servomotor is turned on. Top prevent accidents, check the operation of each individual motor.
- Start up servos according to the servo start-up procedure described below.
- The servo amplifier cooling fins, regenerative resistor, and servomotors become hot during operation and can remain hot for some time after power is turned off. Do not touch these parts or burn injuries may result.
- To avoid injury, turn off the power before touching servomotor shafts or machinery connected to them.
- To avoid injury, do not approach machinery during trial or teaching operation.

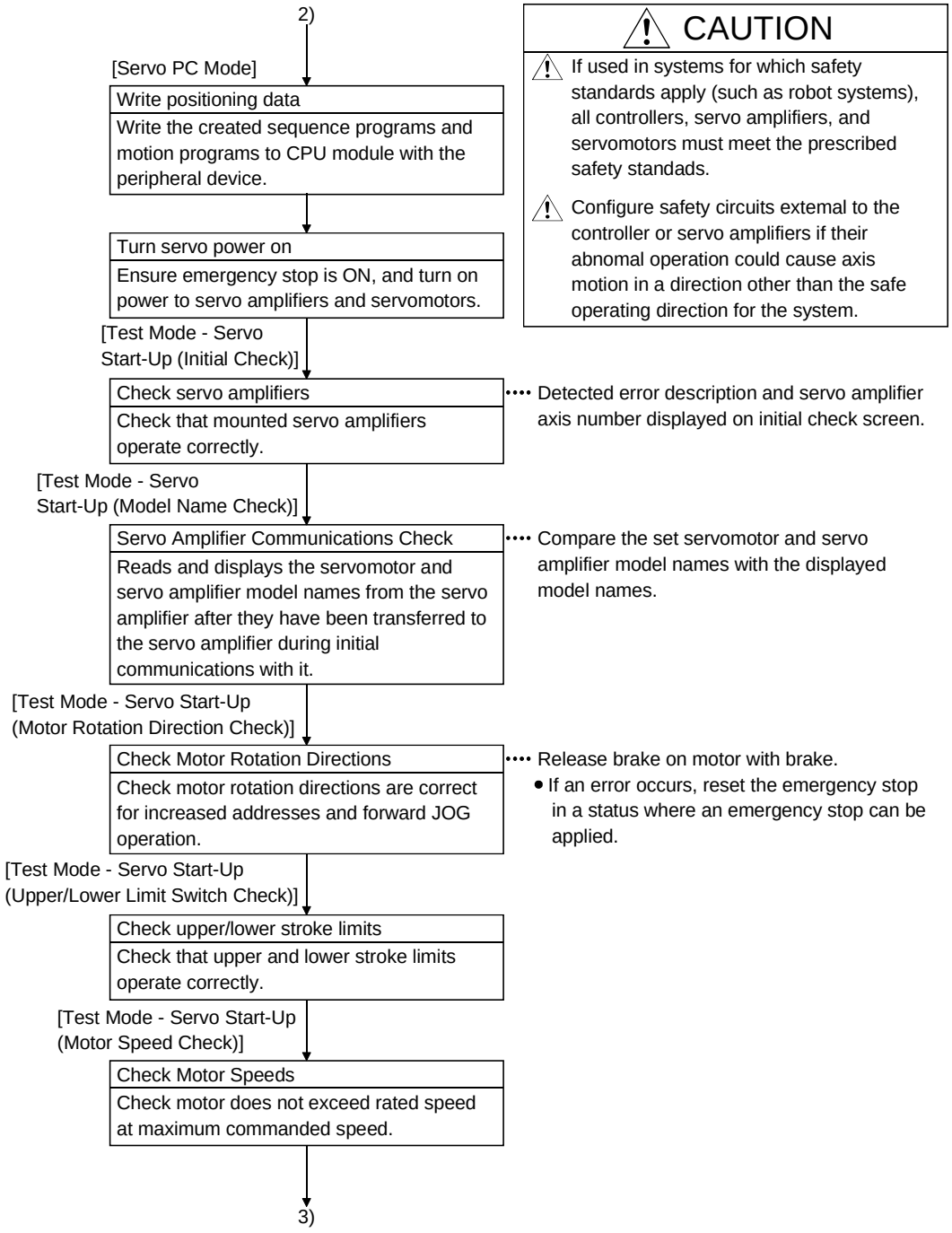
4.2 Trial Run and Adjustment Procedure

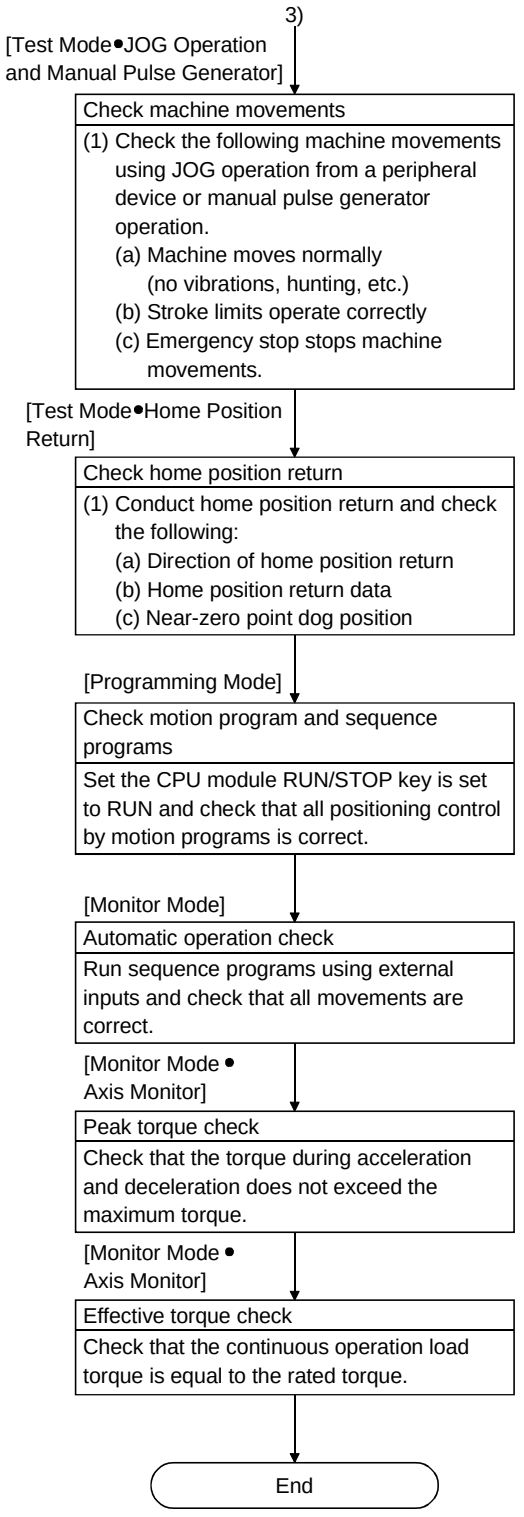
POINTS

(1) Make note of motor model names before the motor is installed on a machine. The motor name plate may not be visible after the motor is installed.
(2) The machine may make unpredictable movements after a servo amplifier or servomotor is first turned on. To prevent accidents, check the operation of each individual motor.




1)
[Install Mode]
Install operating system
Install the positioning OS into the CPU module from the peripheral device.
[Data Setting Mode]
Set positioning parameters
(1) Set the following positioning parameters from the peripheral device:
(a) Fixed parameters
(b) Servo parameters
(c) Home position return data
(d) Limit switches
(e) Control data
[Monitor Mode]
Check external inputs to A172SENC
(1) Check the wiring for the following external inputs by monitoring at a peripheral device or by using the LED indicators.
(Input signals' PX0 to PXF)
(a) FLS (upper limit switch input)
(b) RLS (lower limit switch input)
(c) STOP (stop command)
(d) DOG/CHANCE (near-zero point dog, speed/position switching commad)
[Programming Mode]
Write motion programs
Create motion programs from the peripheral device.
[Programming Mode]
Create sequence programs
Create sequence programs from the peripheral device to run the motion programs.
[Sequence Mode]
Write sequence programs
Write the created sequence programs to CPU module with the peripheral device.
2)
CAUTION
Do not connect a phase-advancer capacitor, surge absorber, or radio noise filter (FR-BIF option) to the servo amplifier output.
Ensure output teminals U, V, W, are correctly connected. Abnomal servomotor operation may result if the teminals are incorrctly connected.
•••• See Section 4.3.
CAUTION
Set parameter values to match the controllers, servo amplifiers, servomotors, and regenerative resistor models used. Protective functions may not operate correctly if the parameters are set incorrectly.
WARNING
Even if the power is tumed off, do not open the front casing or terminal covers, except to connect wiring or conduct scheduled inspections. Charged components in the controller or servo amplifier can cause electric shocks.
To avoid electric shocks, turn off the power, wait at least ten minutes, then check the voltage with a tester before starting wiring or inspections.
Install controllers, servo amplifiers, and servomotors before connecting wiring. Otherwise, electric shocks or injury can result.
CAUTION
Connect a leak breaker to the controller and servo amplifier power supply.
Provide an extemal emergency stop circuit to instantaneously stop operation and cut off power.
Follow the conditions prescribed in this manual and the product instrction manuals when programming using the program commands.
When programming, follow the conditions prescribed in this manual regarding devices which a fixed application.


2)
[Servo PC Mode]
Write positioning data
Write the created sequence programs and motion programs to CPU module with the peripheral device.
Turn servo power on
Ensure emergency stop is ON, and turn on power to servo amplifiers and servomotors.
[Test Mode - Servo Start-Up (Initial Check)]
Check servo amplifiers
Check that mounted servo amplifiers operate correctly.
•••• Detected error description and servo amplifier axis number displayed on initial check screen.
[Test Mode - Servo Start-Up (Model Name Check)]
Servo Amplifier Communications Check
Reads and displays the servomotor and servo amplifier model names from the servo amplifier after they have been transferred to the servo amplifier during initial communications with it.
•••• Compare the set servomotor and servo amplifier model names with the displayed model names.
[Test Mode - Servo Start-Up (Motor Rotation Direction Check)]
Check Motor Rotation Directions
Check motor rotation directions are correct for increased addresses and forward JOG operation.
•••• Release brake on motor with brake.
● If an error occurs, reset the emergency stop in a status where an emergency stop can be applied.
[Test Mode - Servo Start-Up (Upper/Lower Limit Switch Check)]
Check upper/lower stroke limits
Check that upper and lower stroke limits operate correctly.
[Test Mode - Servo Start-Up (Motor Speed Check)]
Check Motor Speeds
Check motor does not exceed rated speed at maximum commanded speed.
3)
CAUTION
If used in systems for which safety standards apply (such as robot systems), all controllers, servo amplifiers, and servomotors must meet the prescribed safety standads.
Configure safety circuits extemal to the controller or servo amplifiers if their abnomal operation could cause axis motion in a direction other than the safe operating direction for the system.

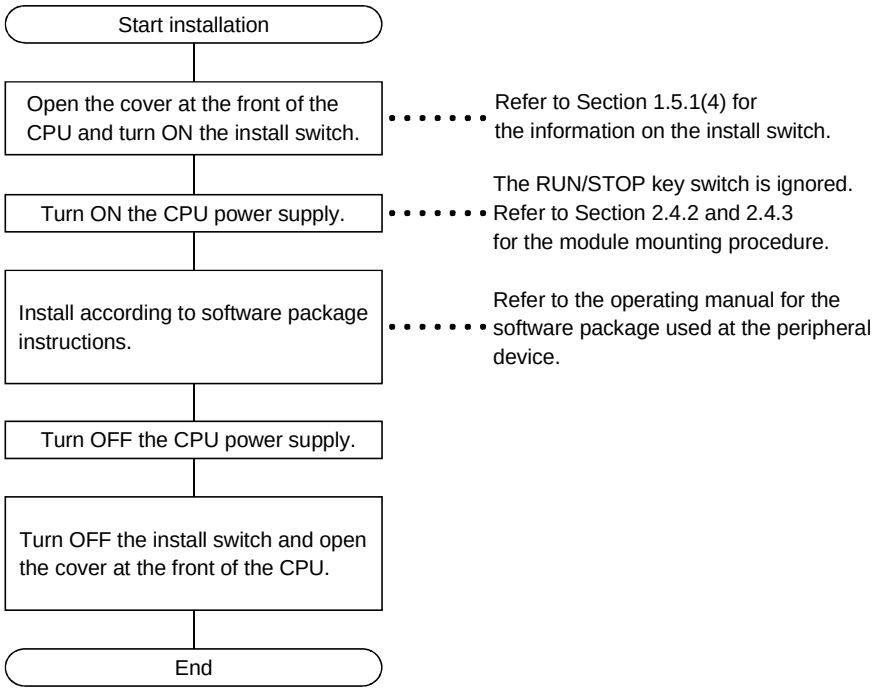


⚠ CAUTION

⚠ Design system with sufficient mechanical allowance for a safe stop if an axis passes the stroke limit switch at maximum speed.

4.3 Operating System Installation Procedure

In the CPU module, the operating system (hereafter abbreviated to the OS) can be changed using the peripheral device and software package.
This OS change is called installation.



POINTS
After completion of installation, always turn OFF the installation switch.

4.4 Trial Run and Adjustment Checklist

At the worksite, copy the following table for use as a check sheet.

Work Step	Item	Trial Run and Adjustment Confirmation	Check
Before power-on	Unit/module mounting and basic wiring	Check that each module is mounted properly.	☐
		Check that each connector is fitted properly.	☐
		Check each terminal screw for looseness.	☐
		Check that earth wires of power supply module, servo amplifiers, etc. are normal.	☐
		Check that motor wiring is proper.	☐
		Check that regenerative brake option wiring is proper.	☐
		Check that emergency stop circuit is proper.	☐
		Check that teaching unit's deadman switch wiring is proper.	☐
		Check that each power supply wire and each I/O wire is proper.	☐
Power-on CPU module in STOP status	OS installation	Check that the motion OS installed is compatible.	☐
	Positioning parameters	Check that each positioning parameter value is proper.	☐
	A172SENC external signals	Check that upper and lower stroke limit inputs are normal.	☐
		Check that STOP signal input is normal.	☐
		Check that near-zero point dog and speed-position change signal inputs are normal.	☐
	Program/positioning data	Check that motion program, sequence program and positioning data are stored in CPU module normally.	☐
	Basic axis operations (Check each axis)	Check that communications with servo amplifiers can be made.	☐
		Check that rotation direction for JOG operation is normal.	☐
		Check that upper and lower limit switches operate normally.	☐
		Check that rotation at maximum command speed is not more than motor rating.	☐
		Check that JOG operation moves machine normally.	☐
		Check that a stop is effected at stroke limit.	☐
		Check that an emergency stop is made.	☐
		Check that home position return is made normally.	☐
		Check that each positioning control of motion program is exercised normally.	☐
CPU module in RUN status	Manual operation	Check each operation in manual operation mode of system with sequence program running.	
		Check that machine operation is stopped immediately by emergency stop.	☐
		Check operation of each actuator and operation confirmation limit switch.	☐
		Check that emergency stop and equipment alarm signals are given properly.	☐
		Make other checks in compliance with control specifications specific to system and equipment.	☐
	Automatic operation	Check each operation in automatic operation mode of system with sequence program running.	
		Check a sequence of automatic operation motions.	☐
		Check that machine operation is stopped immediately by emergency stop.	☐
		Check that module or equipment alarm causes an immediate stop or cycle stop.	☐
		Check that restoring operation can be performed after an alarm stop.	☐
		Make other checks in compliance with control specifications specific to system and equipment.	☐
	Torque check	Check the acceleration/deceleration torque is not more than maximum torque. Check that continuous load torque is rated torque.	☐

5. INSPECTION AND MAINTENANCE

This chapter describes the methods of troubleshooting and daily maintenance and inspection for those who will carry out such works.

5.1 Maintenance Works

This section explains the periodic and daily inspections performed to operate the motion system safely and normally and the actions to be taken for troubles that may take place during motion system operation.

Table 5.1 Maintenance Works

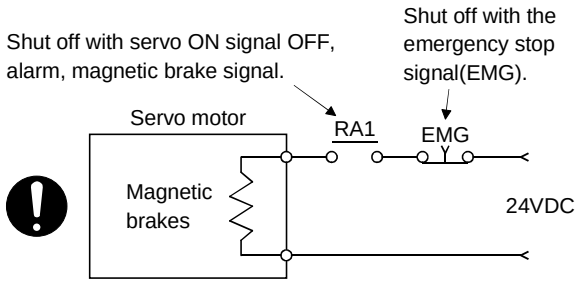
Maintenance Work	Description	Refer To
Daily inspection	Inspection performed daily.	Section 5.2
Periodic inspection	Inspection performed once or twice every six months or every year	Section 5.3
Troubleshooting	Clearing up of system trouble cause and its corrective action	Section 5.4

WARNING

- Do not open the front casing or terminal cover during operation or when power is connected. This can cause electric shocks.
- Do not operate with the front case or terminal cover open. This can cause electric shocks from exposed high-voltage terminals or charged parts.
- Even if the power is turned off, do not open the front casing or terminal covers, except to connect wiring or conduct scheduled inspections. Charged components in the controller or servo amplifier can cause electric shocks.
- To avoid electric shocks, turn off the power, wait at least ten minutes, then check the voltage with a tester before starting wiring or inspections.
- Ground controllers, servo amplifiers, and servomotors to class 3 grounding resistance, or less. Do not share a common ground with other equipment.
- All wiring and inspections to be conducted by a trained technician.
- Install controllers, servo amplifiers, and servomotors before connecting wiring. Otherwise, electric shocks or injury can result.
- Do not operate switches when your hands are wet. This can cause electric shocks.
- Do not scratch, apply undue strain to, place heavy weights on, or trap cables. This can cause electric shocks.
- Do not touch controller, servo-amplifier, or servomotor terminal blocks while power is turned on. This can cause electric shocks.
- Do not touch the controller or servo amplifier internal power supply, internal ground, or signal wires. This can cause electric shocks.

CAUTION

- Perform daily and periodic inspections in accordance with the directions in this manual and the instruction manual for the product used.
- Make backups of controller and servo amplifier programs and parameters before carrying out maintenance and inspection.
- Be careful not to trap your fingers in the gaps when opening and closing parts that can be opened and closed.
- Replace batteries and other consumable parts at the intervals indicated in this manual and the instruction manuals for the products used.
- Do not touch the IC leads or the contacts of connectors.
- Do not place a controller or servo amplifier on a metallic surface where current leakage is possible, or on surfaces that can become charged with static electricity, such as wood, plastics, and vinyl.
- Do not perform a megger test (insulation resistance measurement) during inspections.
- When replacing a controller or servo amplifier, set the settings of the new unit correctly.
- On completing maintenance and inspection, check that position detection by the absolute position sensing function is correct.
- Do not charge, heat, burn, or disassemble batteries.
- Since electrolytic capacitors can generate gases when faulty, do not put your face close to the controller or servo amplifier.
- The electrolytic capacitor and fan deteriorate over time. Replace them regularly in order to avoid secondary accidents in the event of their becoming faulty. These parts must be replaced at a service center or service station.
- If the self-diagnostic error of the controller or servo amplifier has occurred, confirm the check item and recover in accordance with the instruction manual.
- If a hazardous condition is supposed to take place at a power failure or product failure, use the servo motor equipped with an electromagnetic brake or provide an external brake mechanism for a holding purpose to prevent such a condition.
- For the electromagnetic brake operation circuit, make up a double circuit structure so that the brake is actuated by an emergency stop signal provided externally.



- Restart operation after removing the cause of alarm occurrence and ensuring safety.
- After restoration of power from an instantaneous power failure, stay away from the machine since a restart may be made suddenly. (Design the machine so that personal safety may be ensured if a restart is made.)
- Before starting operation, check and adjust the programs and parameters. Not doing so can cause some machines to operate unexpectedly.
- Never make extreme adjustment changes as doing so will make operation instable.
- Apply only the voltage specified in the instruction manual to each terminal. Not doing so can cause burst, damage, etc.
- Ensure that the wires are connected to the corresponding terminals. Not doing so can cause burst, damage, etc.
- Always make sure that polarity is correct (+, -). Not doing so can cause burst, damage, etc.
- While power is on or soon after power-off, do not touch the servo amplifiers' heat sinks, regenerative brake resistors, servo motors and the like as they may be hot. Doing so can cause a burn.
- Always switch power off before touching the servo motor shaft or the machine connected to it. Not doing so can cause injury.
- Stay away from the machine during trial run or teaching or similar operation. Doing so can cause injury.

5.2 Daily Inspections

The inspections listed in the table below should be conducted every day.

Table 5.2 Daily Inspections

No.	Item		Description	Evaluation Standard	Remedy
1	Base unit installation		All screws tight and covers in position.	Must be firmly installed.	Tighten loose screws.
2	I/O(and other) module mounting		Modules correctly mounted in base unit.	Fully mounted and screws tightened.	Tighten loose screws.
3	Connections		Terminal screws tight	Spacing between solderless terminals.	Extension cable connectors
			No loose screws	Correct spacing is maintained.	Connectors fully tightened
			Tighten loose screws	Adjust spacing.	Tighten connector screws
4	Indicators	POWER indicator	Check that indicator lights	Indicator lights (otherwise abnormal)	See Section 5.4.1 (2)
		RUN indicator	Lights in RUN status	Indicator lights (otherwise abnormal)	See Section 5.4.1 (3) (4)
		ERROR indicator	Lights when an error occurs.	Indicator not lit (otherwise error)	See Section 5.4.1 (5) (6)
		INPUT indicator	Check the indicator lighting status.	Indicator lights when input is ON and goes out when input is OFF (otherwise abnormal).	See Section 5.4.1 (7)
		OUTPUT indicator	Check the indicator lighting status.	Indicator lights when output is ON and goes out when output is OFF (otherwise abnormal).	See Section 5.4.1 (7)

5.3 Scheduled Inspections

The inspections listed in the table below should be conducted once or twice every 6 to 12 months. They should also be conducted after equipment is moved or upgraded, and if the wiring is changed.

Table 5.3 Scheduled Inspections

No.	Item		Description	Evaluation Standard	Remedy
1	Ambient environment	Ambient temperature	Measure temperature and humidity. Measure corrosive gases.	0°C to 55°C	If system is in an enclosure, measure temperature and humidity inside the enclosure.
		Ambient humidity		10% to 90% RH	
		Atmosphere		No corrosive gases	
2	Supply voltage		Measure voltage across 100 VAC/200 VAC terminals.	85 VAC to 264 VAC	Change power supply
3	Installation	Looseness	Move units and check	Firmly installed	Tighten screws.
		Dirt, foreign matter	Visual	No dirt or foreign matter	Clean
4	Connections	Loose terminal screws	Turn with a screwdriver	No loose screws	Tighten loose screws
		Spacing between solderless terminals	Visual	Correct spacing is maintained	Adjust spacing
		Loose connectors	Visual	Connectors fully tightened	Tighten connector screws
5	Battery		In monitor mode, check from peripheral device that M9006 and M9007 are OFF.	(Preventative maintenance)	Replace battery if life is exceeded, even if no voltage drop occurs. Refer to Section 5.3.1.

5.3.1 Replacing the Battery

(1) Replacing the CPU module battery

M9006 or M9007 turns ON if the voltage drops from the A6BAT battery which backs up programs and provides memory back-up functions. Program and memory contents are not lost immediately when these special relays turn ON, but memory contents may be lost if this special realy status is overlooked.
After M9006 or M9007 turns ON, replace the battery within the total power-interruption time shown in Table 5.4 below.
This section gives replacement guidelines and describes the replacement method.

(a) Battery life

An alarm occurs and the error message "BATTERY ERROR" is displayed when the battery life has almost expired.
Replace the battery when this alarm occurs. The battery life is approximately 1 year under normal operating conditions at an ambient temperature of 25°C.
The battery life is shown in Table 5.4.

Table 5.4 Battery Life

Battery Life Synchronous Encoder Used/Not Used	Battery Life (Total Power-Interruption Time) (Hr)		
	Guaranteed Time (minimum)	Actual Time (typical)	After M9006, M9007 Turns ON
Not used	5400	13000	168
Used (1 module)	3800	9500	168

*The “actual time” is the average value. The “guaranteed time” is the minimum value.

Preventative Maintenance Guidelines

1) Replace battery every year, even if total power-interruption time is less than the value in the table.
2) Replace the battery if the total power-interruption time exceeds the guaranteed time shown in the table and M9006 is ON.

(b) Replacing a battery

Follow the procedure below to replace a battery when its life expires. After the battery is disconnected, a capacitor maintains memory back-up for a short time. Complete the battery change operation within the time specified in Table 5.5 or the memory contents may be lost.

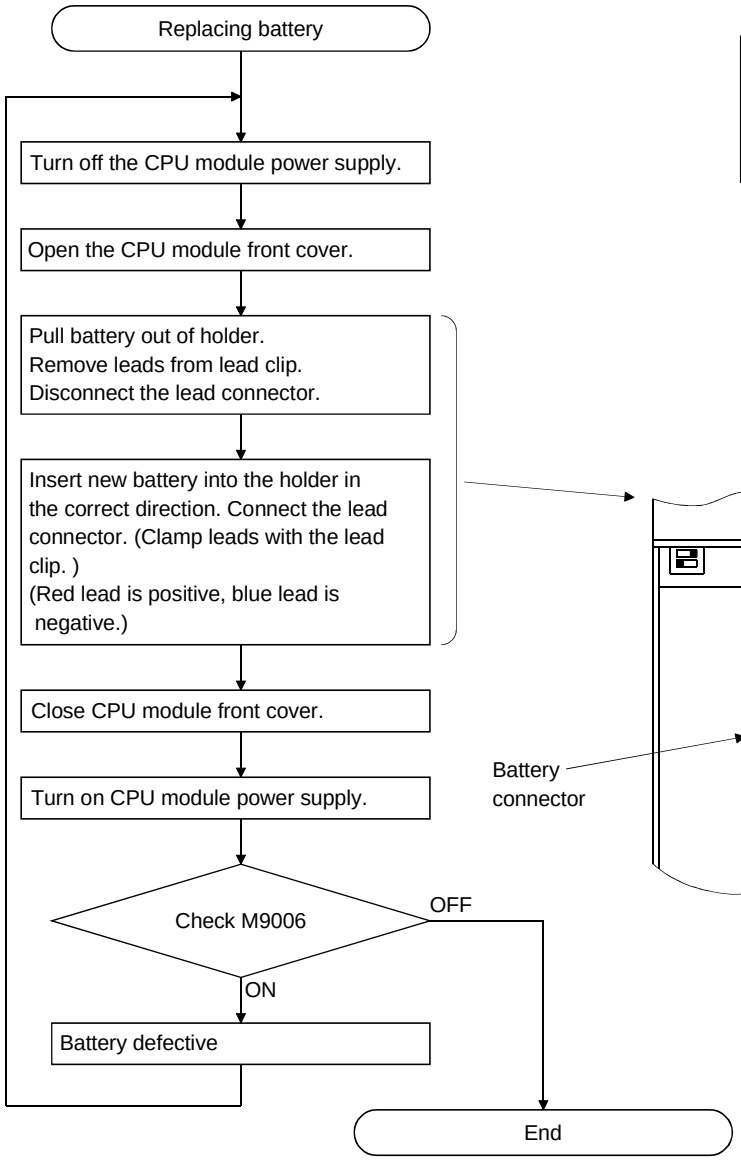
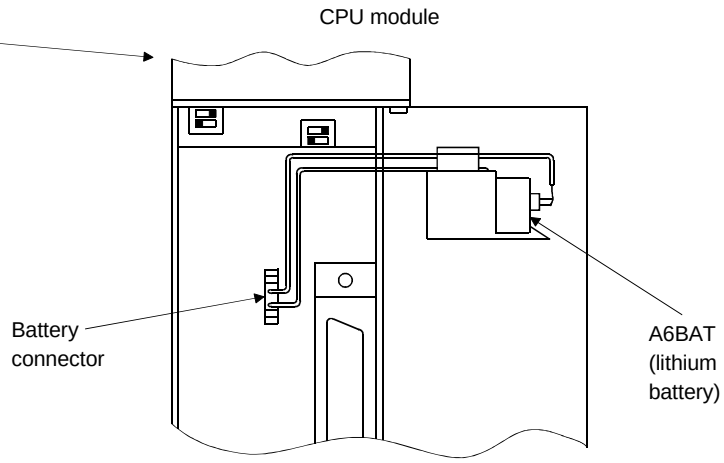


Table 5.5 Capacitor Back-Up Time

Capacitor Back-Up Time (Min.)	
Guaranteed Time (Minimum)	Actual Time (Typical)
5	15



IMPORTANT

Some components mounted on the printed circuit board are sensitive to static electricity. Take the following precautions before directly handling the printed circuit board:
(1) Ground your body or the work bench.
(2) Do not directly touch the conductive parts or electrical components in the product.

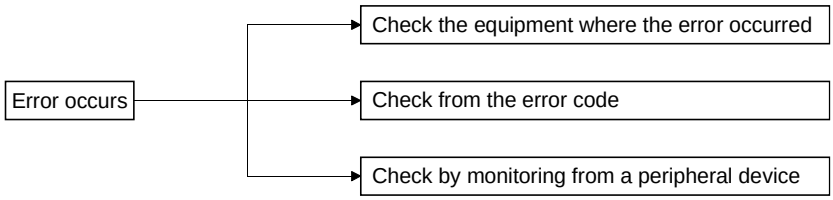
CAUTION

⚠ Dispose of batteries according to local government regulations.

5.4 Troubleshooting

This section describes the errors which could occur when using the system and what to do about them.
Refer to the appropriate software package operating manual for information on the error messages displayed during peripheral device operation.

When an error occurs, the system status can be determined by checking the equipment where the error occurred, from the error codes, or by monitoring with a peripheral device. To quickly recover from an error, use the appropriate method to determine the cause of the error.



(1) Checking the equipment where the error occurred
Visually determine the cause of the error from the indicators on the front of the module, from the operating status of the equipment, etc.

(a) Machine motion (stop status, operating status)

(b) Whether power is on or off

(c) Status of I/O equipment

(d) Wiring status (I/O wires, cables)

(e) Display states of various indicators (e.g. POWER LED, RUN LED, ERROR LED, I/O LED)

(f) Setting states of various setting switches (e.g. extension base, power failure compensation)

After checking (a) to (f), connect the peripheral device and check the CPU module's operating status and program data.

(2) Checking the error codes
Determine the cause of the error by monitoring the error codes stored when the error occurred.
The error code storage devices are listed below.
Refer to the appropriate operating system programming manual for descriptions of the error codes.
(a) Error codes during sequence control
Refer to Section 5.4.1 (10) “Table of Error Codes” for descriptions of the error codes.

Error code	D9008

(b) Error codes during motion control
For error storage devices in motion control, refer to the programming manual of the corresponding OS.

(3) Checking by monitoring from the peripheral device
Use the peripheral device monitor functions to determine the control status. The following statuses can be determined.
Refer to the appropriate peripheral software package operating manual for details about the operating procedures.

(a) Present value monitor
Displays servomotor present value addresses and error codes. It permits the present control status to be checked.

(b) Scroll monitor
Monitor the servo program and motion program operating status, operating axes, and instruction execution in real time. Permit the program operating status to be checked.

(c) Error list monitor
Displays the error code history.
Allows error codes to be checked after multiple errors occur and permits past error codes to be checked.

(d) Trace graph
Graphic display of position command value, position droop, speed command values, servomotor speed, and motor current. The suitability of the servomotor for the machine (factors such as overload status) can be checked by monitoring the servomotor current value.

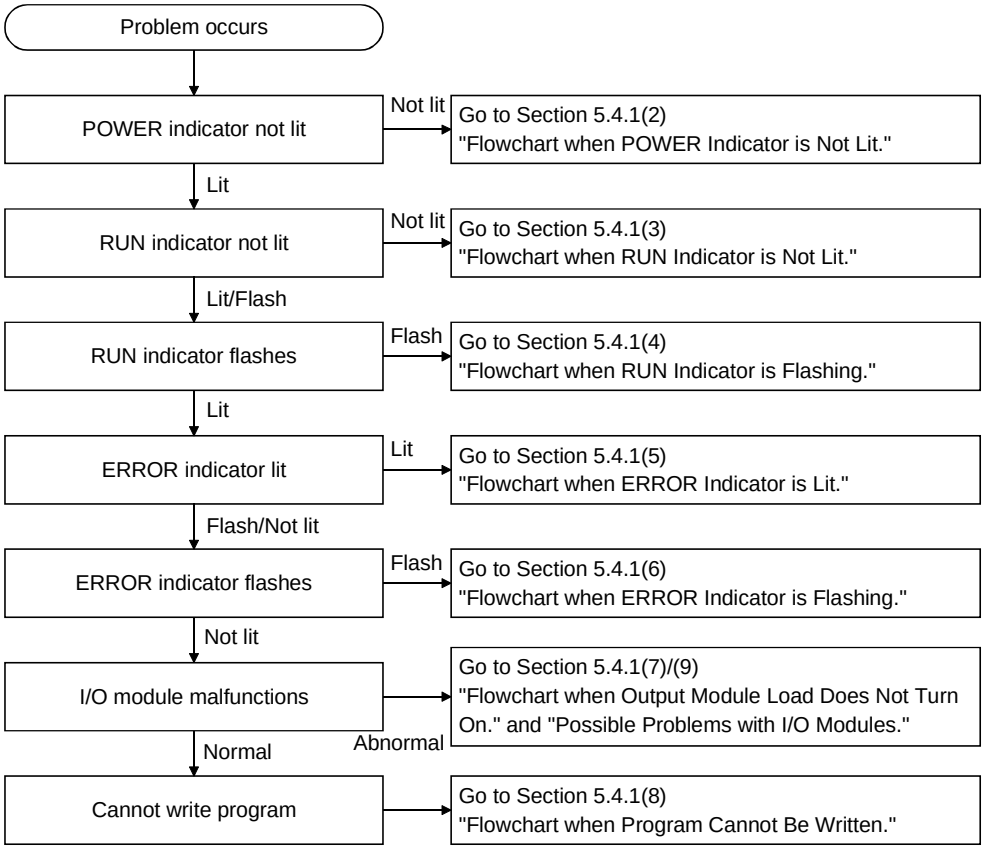
5.4.1 Troubleshooting for CPU Module and I/O Modules

This section explains how to determine the cause of problems occurring in the SCPU of CPU module or I/O modules, and gives descriptions and remedies the errors indicated by each error code. This manual does not give troubleshooting flowcharts that apply to the use of MR-H-BN, MR-J2S-B and MR-J2-B servo amplifiers. Refer to the instruction manual(s) for the servo amplifier(s) you are using:

- MITSUBISHI AC Servo MR-H-BN Instruction Manual
- MITSUBISHI AC Servo MR-J2S-B Instruction Manual
- MITSUBISHI AC Servo MR-J2-B Instruction Manual

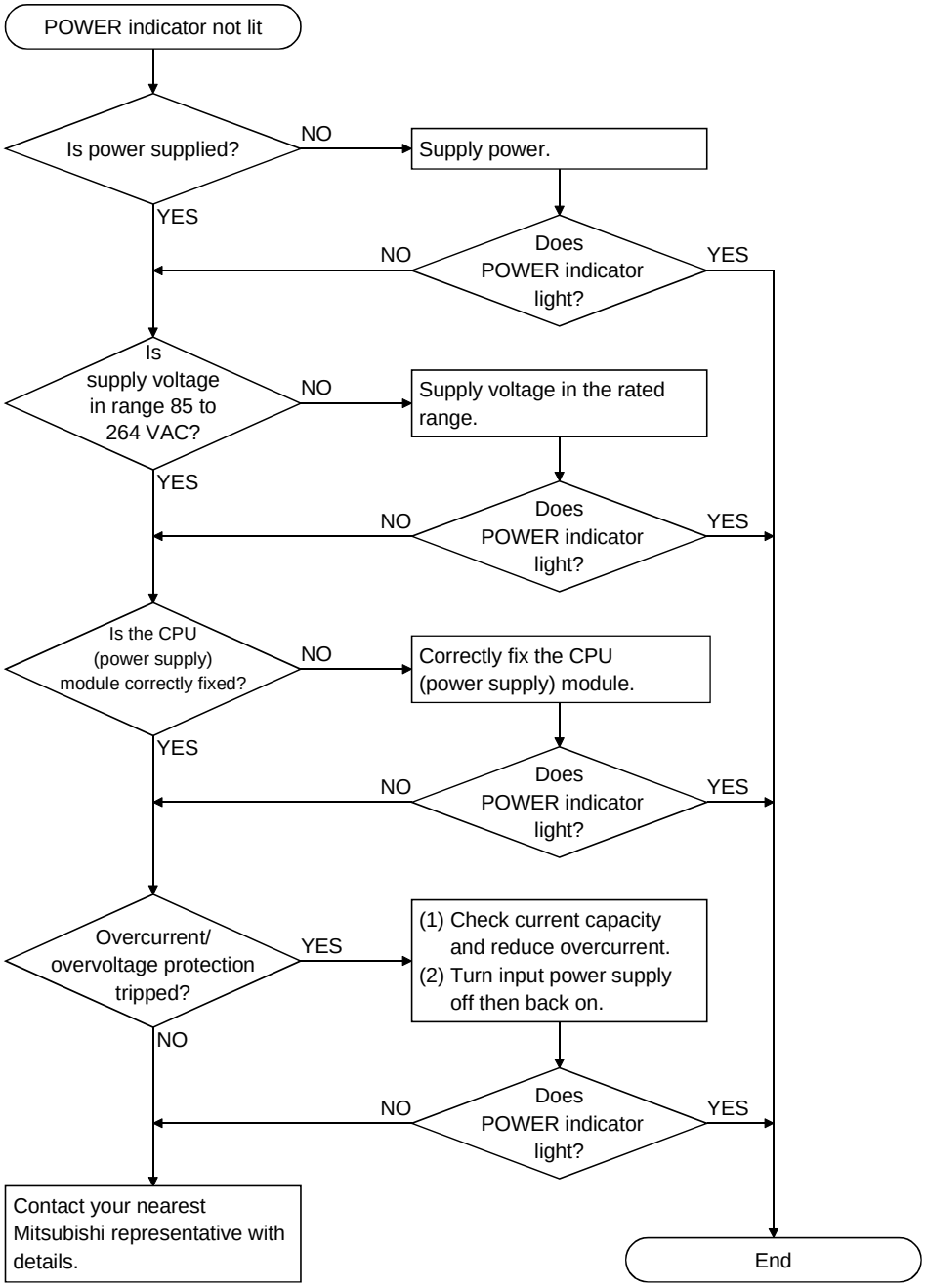
(1) Bagic troubleshooting flow charts

The flowcharts below are classified according to symptoms.



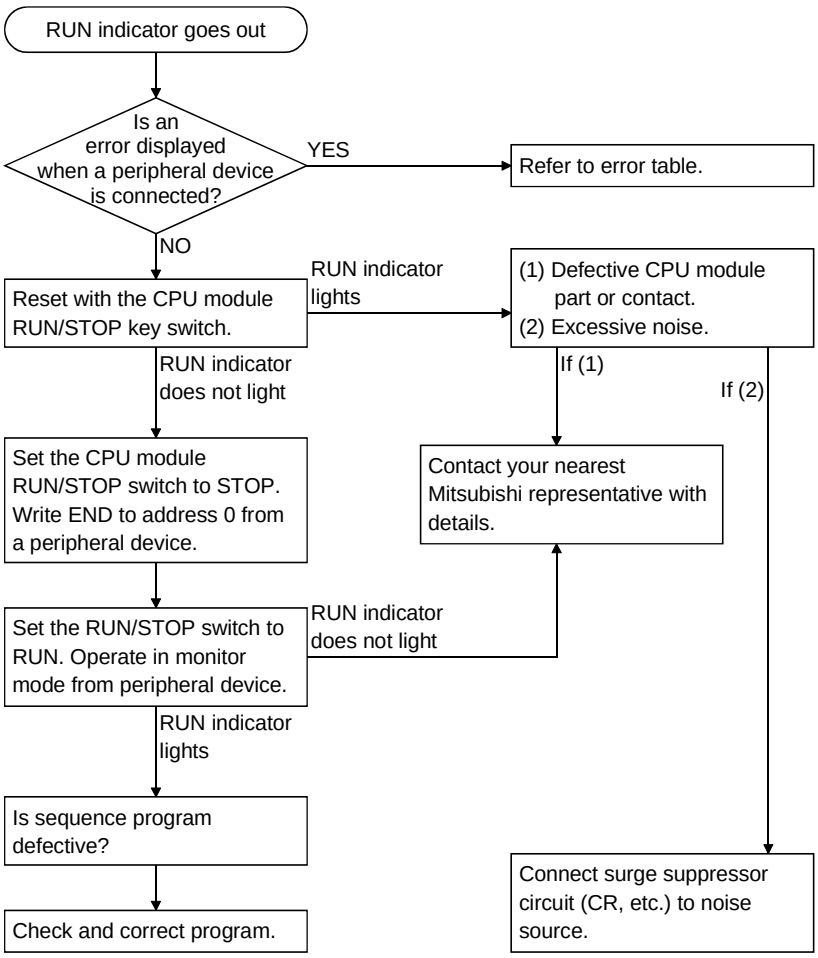
(2) Flowchart when POWER indicator is not lit

Follow the flowchart below if the POWER indicator does not light when the power is turned on or goes out during operation.



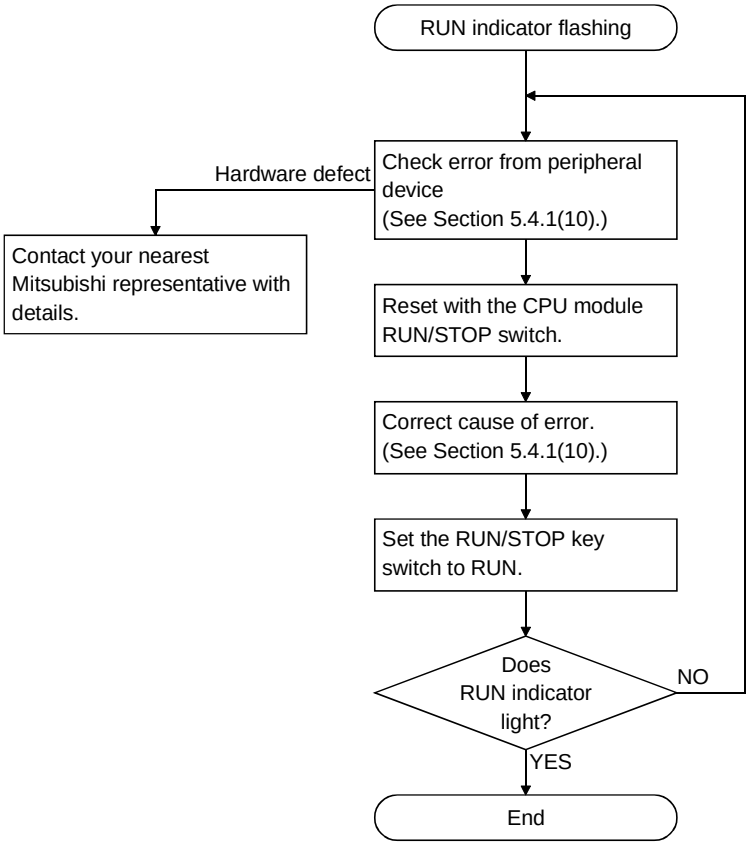
(3) Flowchart when RUN indicator is not lit

Follow the flowchart below if the RUN indicator goes out during operation.



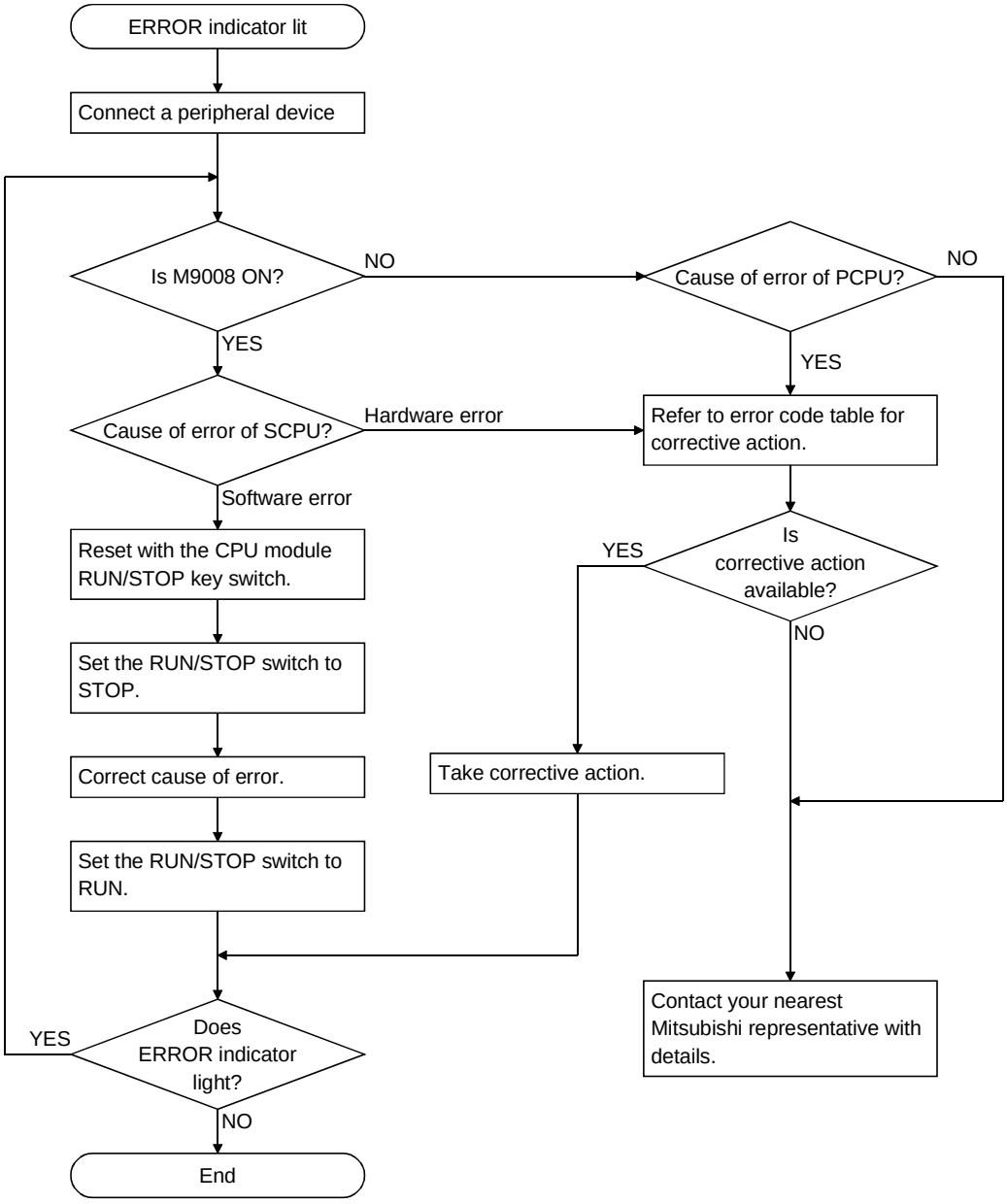
(4) Flowchart when RUN indicator is flashing

Follow the flowchart below if the RUN indicator flashes when the power is turned on or during operation.



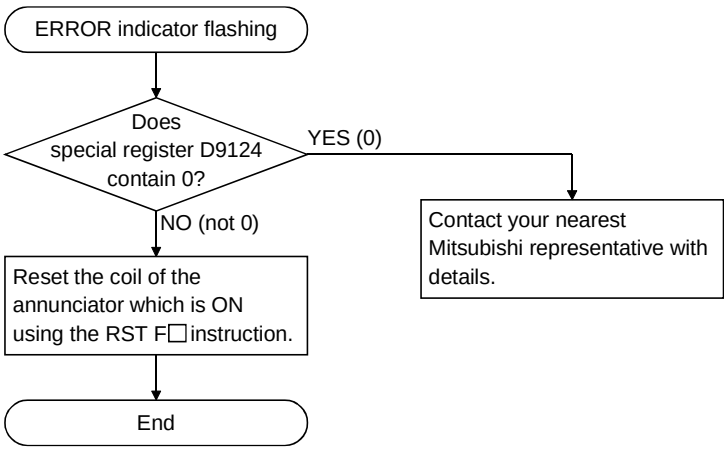
(5) Flowchart when ERROR indicator is lit

Follow the flowchart below if the ERROR indicator lights during operation.



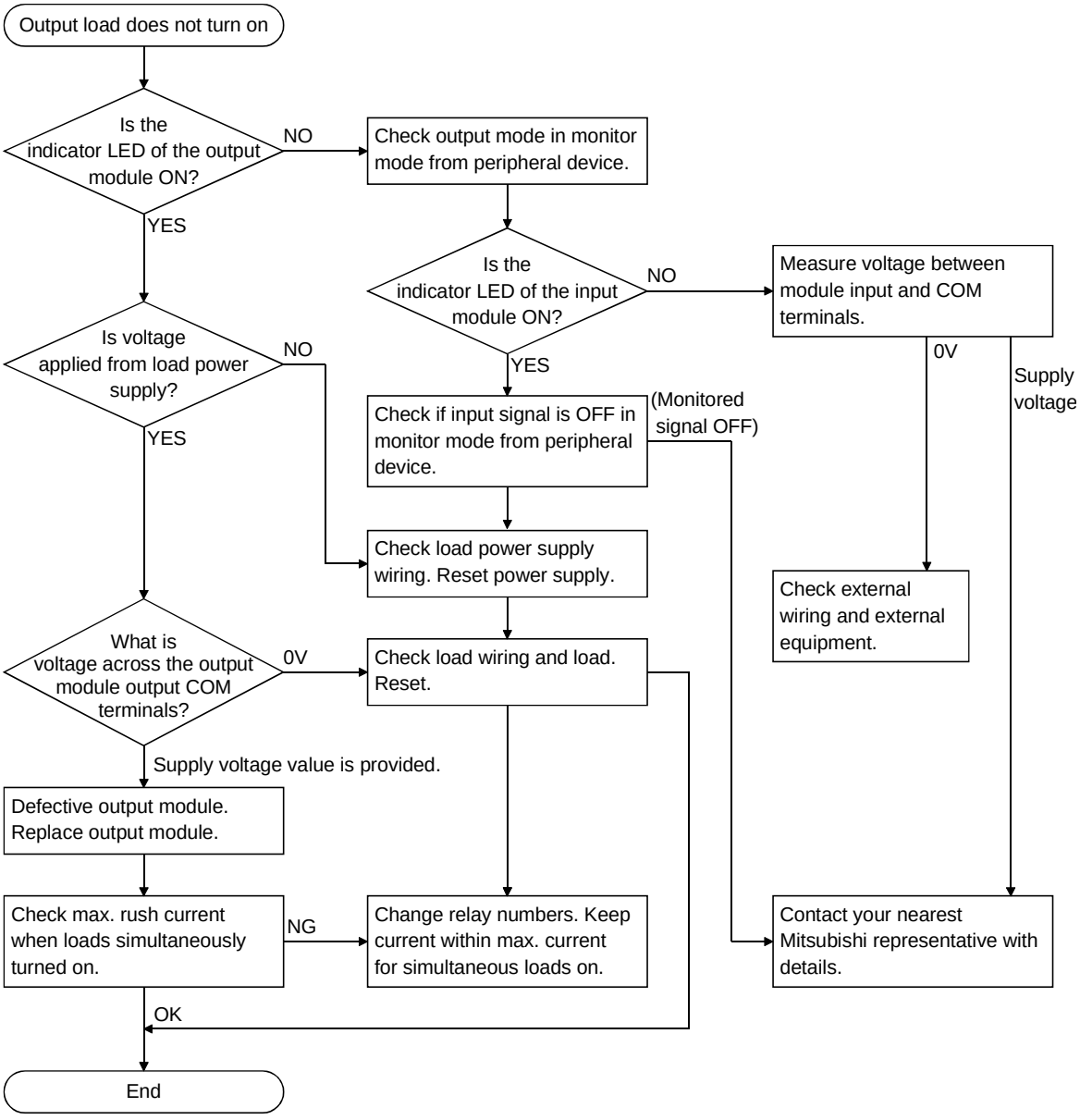
(6) Flowchart when ERROR indicator is flashing

Follow the flowchart below if the ERROR indicator flashes during operation.



(7) Flowchart when output module load does not turn on

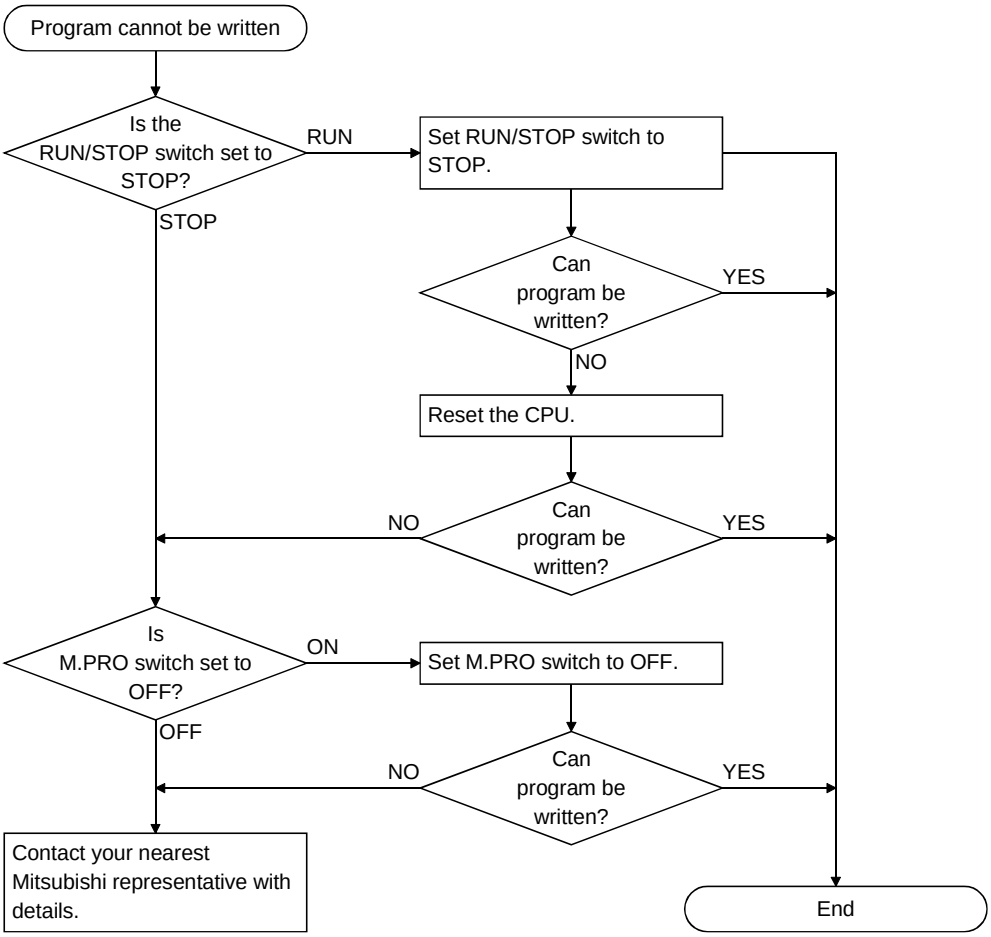
Follow the flowchart below if the output module loads do not turn on during operation.



POINT
If the input signal or load does not turn off, refer to Section 5.4.1 (9) "Possible Problems with I/O Modules."

(8) Flowchart when program cannot be written

The following flowchart assumes that a program or other data cannot be written to the CPU when an attempt was made to write it.



(9) Possible Problems with I/O Modules

This section describes possible problems with input and output circuits, and what to do about them.

(a) Troubleshooting input circuits

Table 5.7 describes problems and corrective actions for input circuits.

Table 5.7 Troubleshooting Input Circuits

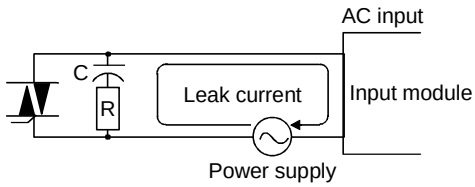
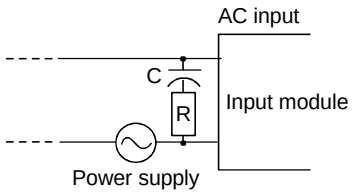
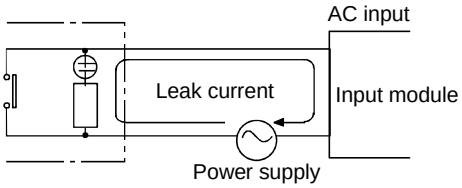
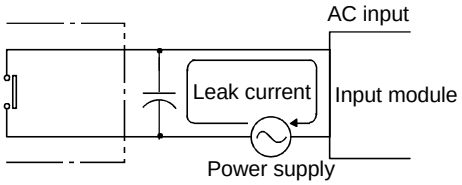
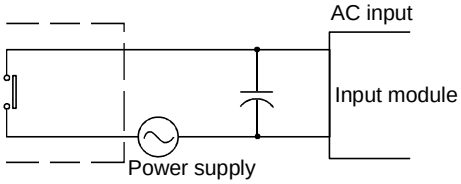
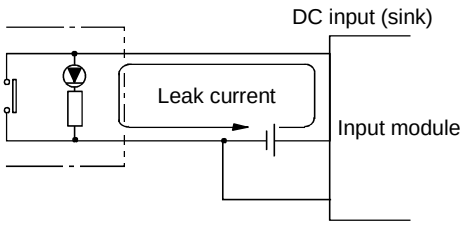
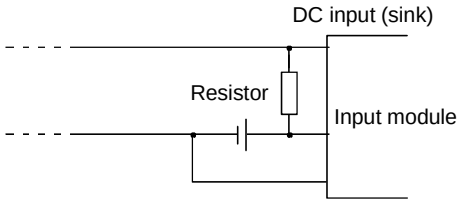
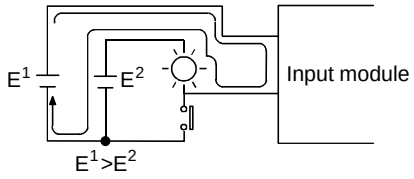
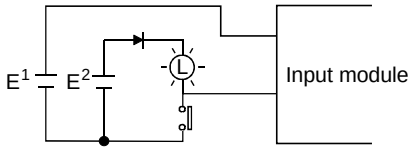
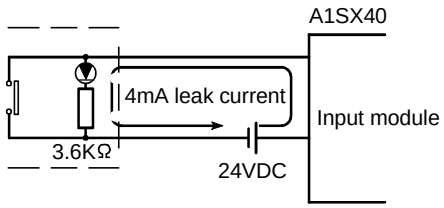
	Symptom	Cause	Corrective Action
Example 1	Input signal does not turn OFF	• Current leakage through input switch. (Driven using a contactless switch, etc.) 	• Connect an appropriate resistor to lower the voltage between the input module terminals below the OFF voltage.  CR constant : 0.1 to 0.47μF + 47 to 120Ω (1/2 W) recommended
Example 2	Input signal does not turn OFF	• Driven using a limit switch with neon lamp. 	• See Problem 1, above. • Alternatively, provide a separate, independent display circuit.
Example 3	Input signal does not turn OFF	• Leak current due to line capacity of wiring. Line capacity (C) of twisted-wire pair is approx. 100 pF/m. 	• See Problem 1, above. • However, this problem does not arise when the power supply is on the input equipment side. 
Example 4	Input signal does not turn OFF	• Driven using a limit switch with LED indicator. 	• Connect an appropriate resistor to lower the voltage between the input module terminal and common terminal below the OFF voltage, as shown below.  * The method of calculating the resistor to connect is shown on the next page.

Table 5.7 Troubleshooting Input Circuits (cont.)

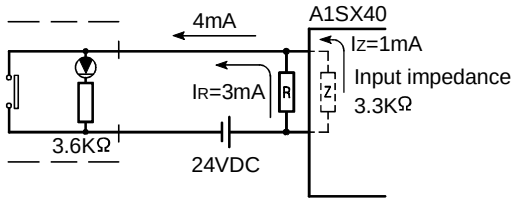
	Symptom	Cause	Corrective Action
Example 5	Input signal does not turn OFF	• Sneak path due to use of two power supplies. 	• Use a single power supply. • Connect a diode to prevent sneak paths, as shown in the diagram. 

<Resistor Resistance Calculation for Example 4>

For the case with a limit switch with LED indicator connected to A1SX40, causing 4 mA leak current.



1) This circuit does not turn OFF because the A1SX40 OFF current of 1 mA is not reached. Therefore, the connection of a resistor is required, as shown below.



2) Resistance calculation

To achieve the A1SX40 OFF current of 1 mA, a resistor should be connected such that a current of 3 mA min. flows through the resistor.

$I_R : I_Z = Z(\text{Input impedance}) : R$

$$R \leqq \frac{I_Z}{I_R} \times (\text{Input impedance}) = \frac{1}{3} \times 3.3 = 1.1[k\Omega]$$

A resistance value of R < 1.1 kΩ

If a 1 kΩ resistor is used, the resistor R power capacity (W) is given by:

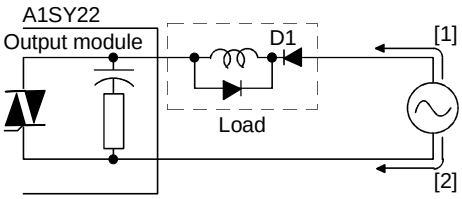
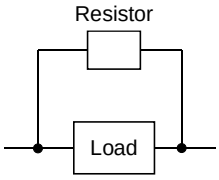
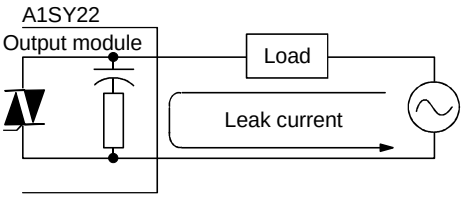
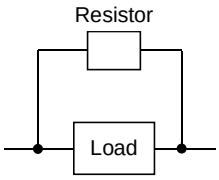
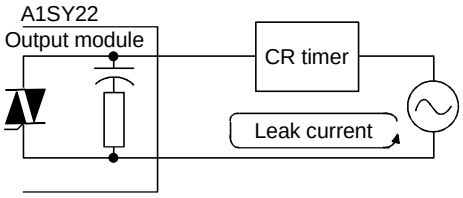
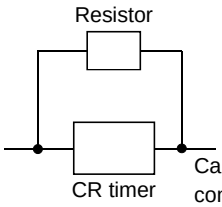
$W = (\text{Current value})^2 \times R = 0.003^2\ (A) \times 1000\ (\Omega) = 0.009\ (W)$

3) In practice, a 1 [kΩ] 0.5 [W] resistor, which has a power capacity 3 to 5 times the actual power consumption, is connected across the terminals where the problem exists.

(b) Troubleshooting output circuits

Table 5.8 describes problems and corrective actions for output circuits.

Table 5.8 Troubleshooting Output Circuits

	Symptom	Cause	Corrective Action
Example 1	Overvoltage applied to load when output turns OFF	• If load is internally half-wave rectified (some solenoids are like this)  • With polarity (1), C is charged. With polarity (2), the C charge voltage plus the power supply voltage is applied across D1. Max. voltage is approx. 2.2V.	• Connect a resistor between several tens kΩ and several hundreds kΩ across the load. (This method causes no problems with output terminals but can lead to deterioration or burn-out of load internal diodes.) 
Example 2	Load does not turn OFF (Triac output)	• Leak current due to internal surge suppresor. 	• Connect a resistor across the load. (If long wiring exists between the output card and the load, leak currents also arise due to wiring capacity.) 
Example 3	Time period fluctuates when load is a CR timer (Triac output)		• Drive a relay and use the relay contacts to drive the CR timer. (See note attached to Example 1, as some timers are half-wave rectified internally.)  Calculate resistor constant from load.

(10) Table of Error Codes of SCPU

If an error occurs when RUN is executed or during CPU module operation, the self-diagnosis function displays an error or stores an error code (including step number) in the special registers. Table 5.9 shows the methods for reading the error codes when an error occurs and describes how to check and correct the error. Take the corrective action described to eliminate the cause of the error.

Table 5.9 Table of Error Codes

Error	Contents (BIN) of Special Register D9008	CPU Status	Error Description and Cause	Corrective Action
"INSTRCT CODE ERR."	10	STOP	The CPU could not decode an instruction code in the program. (1) The memory contents have been changed for some reason and include instruction codes which cannot be decoded.	(1) Read the error step with the peripheral device and modify the program at this step.
"PARAMETER ERROR"	11	STOP	The contents of the CPU memory parameters has been changed by noise.	(1) Read the CPU memory parameters with the peripheral device, check and correct the contents, and rewrite to memory.
"MISSING END INS."	12	STOP	(1) No END (FEND) instruction in program.	(1) Write an END instruction at the end of the program.
"CAN'T EXECUTE (P)"	13	STOP	(1) The jump destination designated by the CJ/SCJ/CALL/CALLP/JMP instruction does not exist or is duplicated. (2) RET instruction exists in program but no CALL instruction. (3) The jump destination of a CJ/SCJ/CALL/CALLP/JMP instruction is after the END instruction. (4) The number of FOR instructions does not match the number of NEXT instructions. (5) A JMP instruction between a FOR and NEXT instruction jumps out of the FOR-NEXT loop. A JMP instruction before the RET instruction jumps out of the sub-routine. (6) A JMP instruction destination is a step between a FOR and NEXT instruction or into a sub-routine.	(1) Read the error step with the peripheral device and correct the program (insert jump destination, eliminate duplicate jump destinations, etc.).

Table 5.9 Table of Error Codes (cont.)

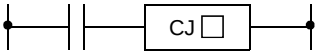
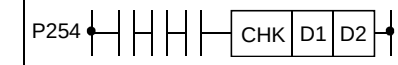
Error	Contents (BIN) of Special Register D9008	CPU Status	Error Description and Cause	Corrective Action
"CHK FORMAT ERR."	14	STOP	(1) A CHK instruction ladder block contains an instruction (including NOP) other than LDX, LDIX, ANDX, ANIX. (2) Multiple CHK instruction exist. (3) More than 150 contacts exist in a CHK instruction ladder block. (4) The X device number in a CHK instruction ladder block exceeds X7FE. (5) No ladder block exists before the CHK instruction ladder block.  (6) The [CHK] [D1] [D2] instruction D1 device number does not match the device number of the contacts before the CJ□ instruction. (7) No pointer P254 exists at the start of the CHK instruction ladder block. 	(1) Check the CHK instruction ladder block for items (1) to (7) in the column to the left. Correct problems with the peripheral device and start operation again. (2) This error message is valid for direct I/O control only.
"CAN'T EXECUTE (I)"	15	STOP	(1) An interrupt module is used, but the program contains no equivalent interrupt pointer I number, or duplicate interrupt pointers. (2) No IRET instruction exists in interrupt program. (3) An IRET instruction exists outside the interrupt program.	(1) Check if an interrupt program exists for the interrupt module, then create an interrupt program or eliminate duplicate I numbers, as appropriate. (2) Check if IRET instruction exists in the interrupt program, and insert, if required. (3) Check if an IRET instruction exists outside the interrupt program, and remove, if necessary.
"RAM ERROR"	20	STOP	(1) A check determined normal reading and writing to the CPU data memory area is not possible.	A problem with the CPU hardware. Contact your nearest Mitsubishi representative with details.
"OPE. CIRCUIT ERR."	21	STOP	(1) The CPU operation circuits which handle sequence processing are inoperative.	
"WDT ERROR"	22	STOP	The scan time exceeded the watchdog timer set time. (1) Scan time too long because of user program conditions. (2) Scan time too long because of instantaneous power interruption during scan.	(1) Calculate and check the scan time in the user program, reduce the scan time with the CJ instruction. (2) Monitor the contents of special register D9005 from a peripheral device. A non-zero value indicates an unstable power supply voltage. If the value is not 0, check the power supply and reduce the voltage fluctuations.

Table 5.9 Table of Error Codes (cont.)

Error	Contents (BIN) of Special Register D9008	CPU Status	Error Description and Cause	Corrective Action
"END NOT EXECUTE"	24	STOP	(1) During execution, the END code was read as a different instruction code due to noise, or some other cause. (2) The END instruction changed to another instruction code for some reason.	(1) Reset the CPU and run again. If the same error is displayed again, a problem exists in the CPU hardware. Contact your nearest Mitsubishi representative with details.
"WDT ERROR"	25	STOP	A sequence program run by a CJ instruction is stuck in a loop and the END instruction cannot be executed.	Check if a program contains an infinite loop and modify, as required.
"UNIT VERIFY ERR."	31	STOP (RUN)	Problem with I/O module at power on. (1) During operation, the I/O module (induding the special function module) is loose or has come out of its slot, or the wrong module is mounted.	(1) The bit corresponding the module causing the verification error is set to “1” in special register D9116. Monitor the contents of this special register from the peripheral device. Check the module where the error occurred and replace, if necessary. (2) If the module position is correct, reset with the RUN/STOP key switch.
"FUSE BREAK OFF"	32	STOP (RUN)	(1) A fuse is blown in an output module. (2) The external power supply for the output load is turned off or not connected.	(1) Check the ERR indicator on each output module and replace the module with the indicator lit. (2) The module with a blown fuse can also be identified from a peripheral device. The bit corresponding the module with the blown fuse is set to 1 in special register D9100. Monitor the contents of this special register to identify the module. (3) Ensure that the external power supply for the output load is turned on.
"CONTROL-BUS ERR."	40	STOP	FROM and TO instructions could not be executed. (1) Control bus error with a special-function module.	(1) A hardware error exists in a special-function module, CPU module, or the main base unit. Replace the module or unit and check the defective module or unit for defects. Contact your nearest Mitsubishi representative with details.
"SP. UNIT DOWN"	41	STOP	When a FROM or TO instruction was executed, no reply was received that the special-function module was accessed. (1) The accessed special-function module is defective.	A hardware error exists in the accessed special-function module. Contact your nearest Mitsubishi representative with details.

Table 5.9 Table of Error Codes (cont.)

Error	Contents (BIN) of Special Register D9008	CPU Status	Error Description and Cause	Corrective Action
"I/O INT. ERROR"	43	STOP	An interrupt was generated but no interrupt module is mounted.	(1) A hardware error exists in one of the modules. Replace the module and check the defective module for defects. Contact your nearest Mitsubishi representative with details.
"SP. UNIT LAY. ERR."	44	STOP	(1) Three or more computer link modules are loaded for one A171SHCPUN/A172SHCPUN CPU module, or seven or more computer link modules are loaded for one A173UHCPU CPU module. (2) Two or more A1SJ71AP21/R21s or A1SJ71T21Bs are loaded for A171SHCPUN/A172SHCPUN, or three or more A1SJ71AP21/R21s or A1SJ71T21Bs are loaded for A173UHCPU. (3) Two or more interrupt modules mounted. (4) The I/O allocation set in the peripheral device parameters allocate a special-function module where an I/O module is mounted, or vice-versa.	(1) Reduce computer link modules to two or less for A171SHCPUN/A172SHCPUN or to six or less for A173UHCPU. (2) Reduce A1SJ71AP21/R21 or A1SJ71T21B to one or less for A171SHCPUN/A172SHCPUN or to two or less for A173UHCPU. (3) Mount 1 interrupt module. (4) Change the I/O allocation set in the peripheral device parameters to match the special-function modules mounted.
"SP. UNIT ERROR"	46	STOP (RUN)	(1) An attempt was made to access (by executing FROM and TO instructions) a position where no special-function module is mounted.	(1) Read the error step with the peripheral device and check and modify the FROM and TO instructions at this step.
"LINK PARA. ERROR"	47	RUN	(1) The contents written to the link parameter area after parameter setting at a peripheral device differ from the link parameter contents read by the CPU. (2) The total number of slave stations is set to zero.	(1) Write the parameters again and check. (2) If the same error is displayed again, a problem exists in the hardware. Contact your nearest Mitsubishi representative with details.
"OPERATION ERROR"	50	RUN (STOP)	(1) BCD conversion result exceeds the prescribed limit (9999 or 99999999). (2) Operation not possible because a setting was outside the prescribed device range. (3) A program used a file register for which the file register size is not set.	(1) Read the error step with the peripheral device and check and modify the program at this step. (Check the device setting range, BCD conversion range, etc.)
"BATTERY ERROR"	70	RUN	(1) Battery voltage is below the prescribed limit. (2) Battery lead connector is not connected.	(1) Replace the battery. (2) Connect the battery lead connector to use the internal RAM or memory back-up function.

(11) Reading error codes

The error code can be read from a peripheral device after an error occurs.
Refer to the peripheral device operating manual for details.

APPENDICES

Appendix 1 Cables

Appendix 1.1 SSCNET Cables

Generally use the SSCNET cables of our options. If the length you need is not found in our options, fabricate the cable on the customer side.

(1) Selection

The following table indicates the SSCNET cables used with the servo amplifiers. Make selection according to your operating conditions.

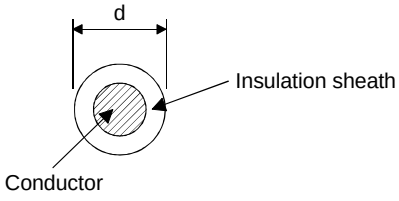
	Type	Description
SSCNET cable	MR-HBUS□M	• For connection of CPU module and MR-H-BN • For connection of MR-H-BN and MR-H-BN
	MR-J2HBUS□M-A	• For connection of CPU module and MR-J2S-B/MR-J2-B • For connection of MR-H-BN and MR-J2S-B/MR-J2-B
	MR-J2HBUS□M	• For connection of MR-J2S-B/MR-J2-B and MR-J2S-B/MR-J2-B

Use the following or equivalent twisted pair cables as the SSCNET cables.

Type	Length [m]	Wire Model
MR-HBUS□M	0.5 to 5	A14B2343 6P
MR-J2HBUS□M-A	0.5 to 5	UL20276 AWG#28 10 pairs (cream)
MR-J2HBUS□M		

Wire Model	Core Size [mm^2]	Number of Cores	Characteristics of One Core			Finish OD [mm][*3]
			Structure [Number of wires/mm]	Conductor resistance [Ω/km]	Insulating sheath OD d[mm] [*1]	
UL20276 AWG#28 10 pairs (cream)	0.08	20 (10 pairs)	7/0.127	222 max.	0.38	6.1
A14B2343 6P[*2]	0.2	12 (6 pairs)	40/0.08	105 max.	0.88	7.2

*1: d is as shown below.



*2: Supplier: Toa Electric Industry

*3: Standard OD. Max. OD is about 10% greater.

CAUTION

⚠ When fabricating the bus cable, make correct connection. Wrong connection will cause runaway/explosion.

(2) MR-HBUS□M

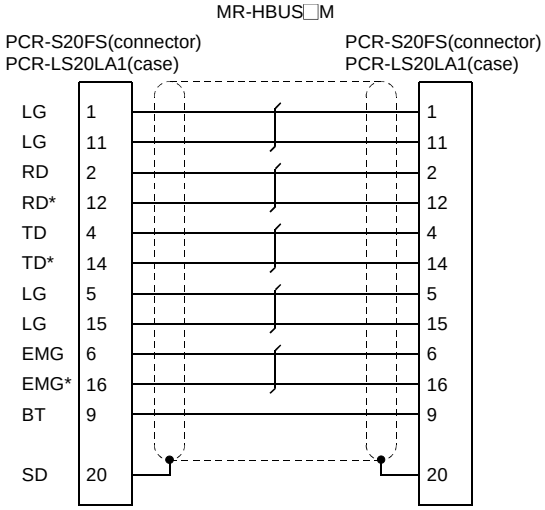
(a) Explanation of type

Type: MR-HBUS□M

Symbol	Cable Length [m]
05	0.5
1	1
5	5

(b) Connection diagram

When fabricating a cable, use the recommended wire given on Appendix 1.1 (1), and make the cable as shown in the following connection diagram. The overall distance of the SSCNET cables on the same bus is 30m.



(3) MR-J2HBUS□M-A

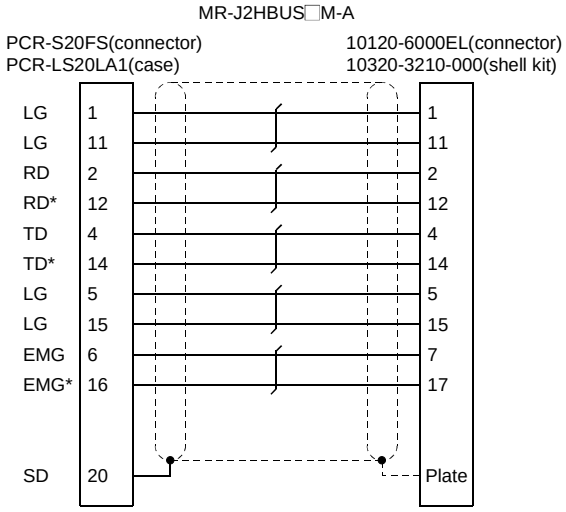
(a) Explanation of type

Type: MR-J2HBUS□M-A

Symbol	Cable Length [m]
05	0.5
1	1
5	5

(b) Connection diagram

When fabricating a cable, use the recommended wire given on Appendix 1.1 (1), and make the cable as shown in the following connection diagram. The overall distance of the SSCNET cables on the same bus is 30m.



(4) MR-J2HBUS□M

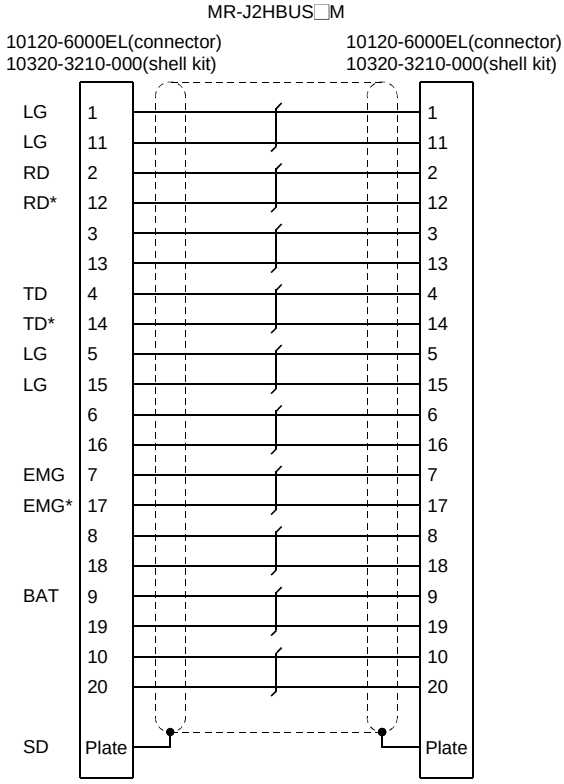
(a) Explanation of type

Type: MR-J2HBUS□M

Symbol	Cable Length [m]
05	0.5
1	1
5	5

(b) Connection diagram

When fabricating a cable, use the recommended wire given on Appendix 1.1 (1), and make the cable as shown in the following connection diagram. The overall distance of the SSCNET cables on the same bus is 30m.



Appendix 1.2 Encoder Cables

Generally use the encoder cables of our options. If the length you need is not found in our options, fabricate the cable on the customer side.

(1) Selection

The following table indicates the encoder cables used with the servo motors. Make selection according to your operating conditions. Connector sets are also available for your fabrication.

Encoder Cable		Connector Set		Servo Motor Type		
Type	Protective structure	Type	Protective structure	MR-H compatible	MR-J2 compatible	MR-J2-Super compatible
MR-HSCBL□M	IP20	MR-JSCNS	IP20	HA-LH□K HC-SF HC-RF HC-UF 2000r/min	—	—
MR-EN1CBL□M-H	IP65	MR-EN1CNS	IP65			
MR-JHSCBL□M-L, H	IP20	MR-J2CNS	IP20	—	HC-SF HC-RF HC-UF 2000r/min	HC-SFS HC-RFS HC-UFS 2000r/min
MR-ENCBL□M-H	IP65, IP67	MR-ENCNS	IP65, IP67			
MR-JCCBL□M-L, H[*1]	IP20	MR-HCNM	IP20	HC-MF HA-FF HC-UF 3000r/min	—	—
		MR-J2CNM		—	HC-MF HA-FF HC-UF 3000r/min	HC-MFS HA-KFS HC-UFS 3000r/min

*1: For use of any of the above cables with the MR-H, the MR-HCN2 conversion connector is required.

Use the following or equivalent twisted pair cables as the encoder cables.

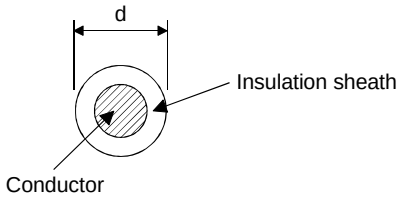
Type	Length [m]	Cable Type
MR-HSCBL□M	2/5	A14B2339 4P
	10 to 30	A14B2343 6P
MR-EN1CBL□M-H	2/5	A14B2339 4P
	10 to 30	A14B2343 6P
MR-JCCBL□M-L	2 to 10	UL20276 AWG#28 7 pair (BLAC)
	20/ 30	UL20276 AWG#22 6 pair (BLAC)
MR-JCCBL□M-H	2/5	A14B2343 6P
	10 to 30	A14B0238 7P
MR-JHSCBL□M-L	2/5	UL20276 AWG#28 4 pair (BLAC)
	10 to 30	UL20276 AWG#22 6 pair (BLAC)
MR-JHSCBL□M-H	2/5	A14B2339 4P
	10 to 30	A14B2343 6P
MR-ENCBL□M-H	2/5	A14B2339 4P
	10 to 30	A14B2343 6P

⚠ CAUTION

⚠ When fabricating the encoder cable, make correct connection. Wrong connection will cause runaway/explosion.

Wire Model	Core Size [mm^2]	Number of Cores	Characteristics of One Core			Finish OD [mm]*3
			Structure [Number of wires/mm]	Conductor resistance [Ω/km]	Insulating sheath OD d[mm] *1	
UL20276 AWG#28 7 pairs (BLAC)	0.08	14 (7 pairs)	7/0.127	222 max.	0.38	5.6
UL20276 AWG#28 4 pairs (BLAC)	0.08	8 (4 pairs)	7/0.127	222 max.	0.38	4.7
UL20276 AWG#22 6 pairs (BLAC)	0.3	12 (6 pairs)	12/0.18	62 max.	1.2	8.2
A14B2343 6P*2	0.2	12 (6 pairs)	40/0.08	105 max.	0.88	7.2
A14B2339 6P*2	0.2	8 (4 pairs)	40/0.08	105 max.	0.88	6.5
A14B0238 7P*2	0.2	12 (6 pairs)	40/0.08	105 max.	0.88	8.0

*1: d is as shown below.



*2: Supplier: Toa Electric Industry

*3: Standard OD. Max. OD is about 10% greater.

(2) MR-HSCBL□M (Long flexing life product)

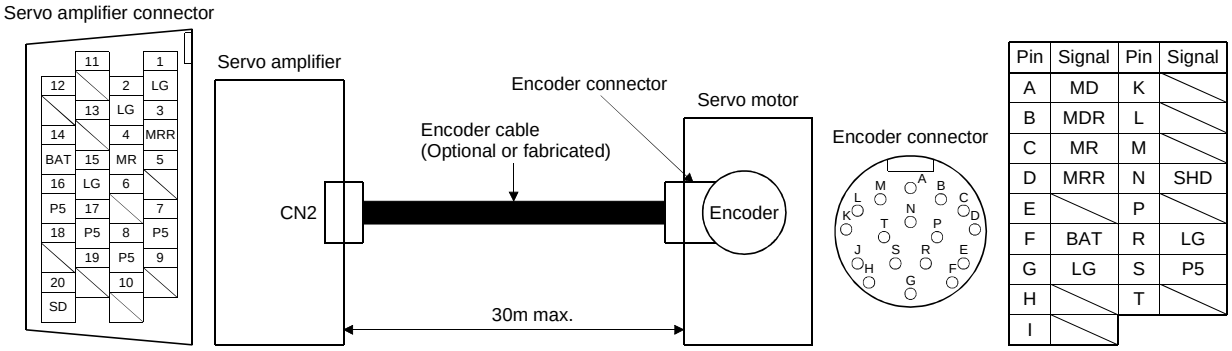
(a) Explanation of type

Type: MR-HSCBL□M

Symbol	Cable Length [m]
2	2
5	5
10	10
20	20
30	30

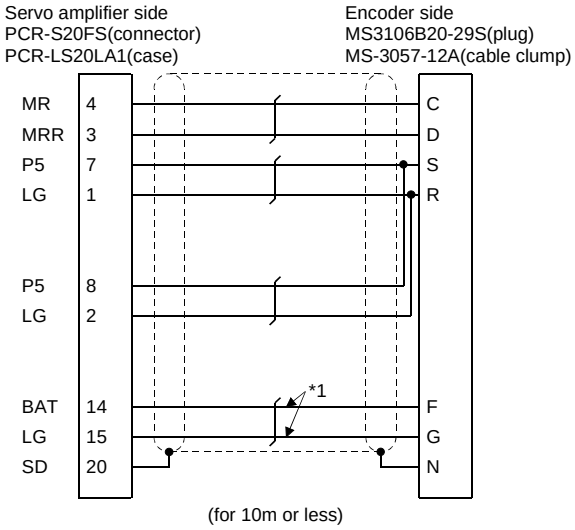
(b) Connection diagram

When fabricating a cable, use the recommended wire and encoder cable fabricating connector set given on Appendix 1.2 (1), and make the cable as shown in the following connection diagram. This connection allows you to fabricate an up to 30m length of cable including the encoder cable supplied to the servo motor.

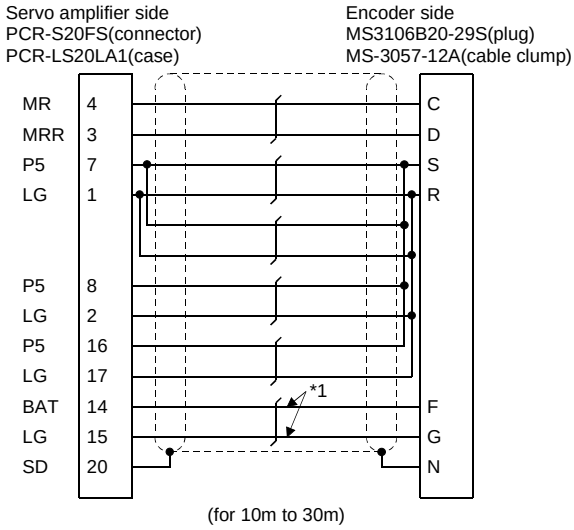


Pin	Signal	Pin	Signal
A	MD	K	
B	MDR	L	
C	MR	M	
D	MRR	N	SHD
E		P	
F	BAT	R	LG
G	LG	S	P5
H		T	
I			

MR-HSCBL2M
MR-HSCBL5M



MR-HSCBL10M to MR-HSCBL30M



*1: Always make connection for use in the absolute position detection system.
Wiring is not needed for use in the incremental system.

(3) MR-EN1CBL□M-H (Long flexing life product)

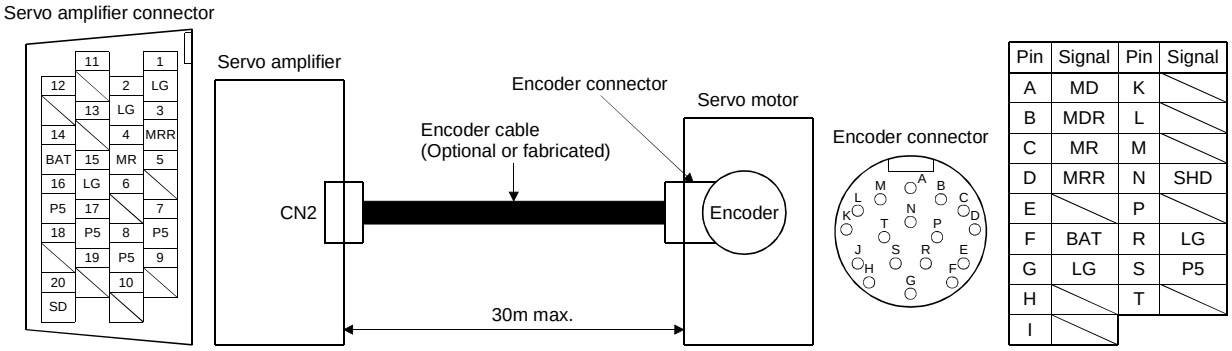
(a) Explanation of type

Type: MR-EN1CBL□M-H

Symbol	Cable Length [m]
2	2
5	5
10	10
20	20
30	30

(b) Connection diagram

When fabricating a cable, use the recommended wire and encoder cable fabricating connector set given on Appendix 1.2 (1), and make the cable as shown in the following connection diagram. This connection allows you to fabricate an up to 30m length of cable including the encoder cable supplied to the servo motor.

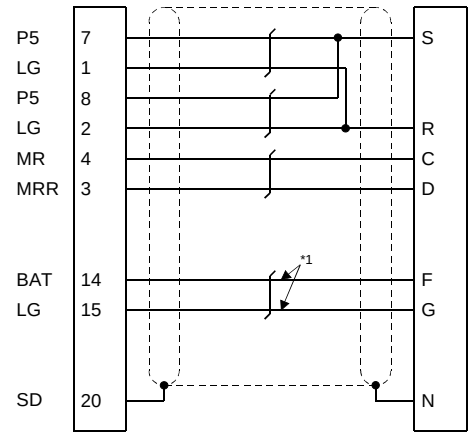


Pin	Signal	Pin	Signal
A	MD	K	
B	MDR	L	
C	MR	M	
D	MRR	N	SHD
E		P	
F	BAT	R	LG
G	LG	S	P5
H		T	
I			

MR-EN1CBL2M-H
MR-EN1CBL5M-H

Servo amplifier side
PCR-S20FS(connector)
PCR-LS20LA1(case)

Encoder side
MS3106A20-29S(D190)(plug)
CE3057-12A-3(D265)(cable clump)
CE02-20BS-S(back shell)

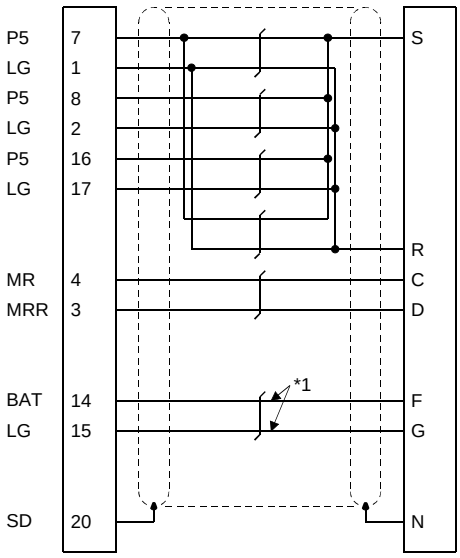


AWG24 used
(for less than 10m)

MR-EN1CBL10M-H to MR-EN1CBL30M-H

Servo amplifier side
PCR-S20FS(connector)
PCR-LS20LA1(case)

Encoder side
MS3106A20-29S(D190)(plug)
CE-3057-12A-3(D265)(cable clump)
CE02-20BS-S(back shell)



AWG24 used
(for 10m to 30m)

*1: Always make connection for use in the absolute position detection system.
Wiring is not needed for use in the incremental system.

(4) MR-JHSCBL□M-L/MR-JHSCBL□M-H

(a) Explanation of type

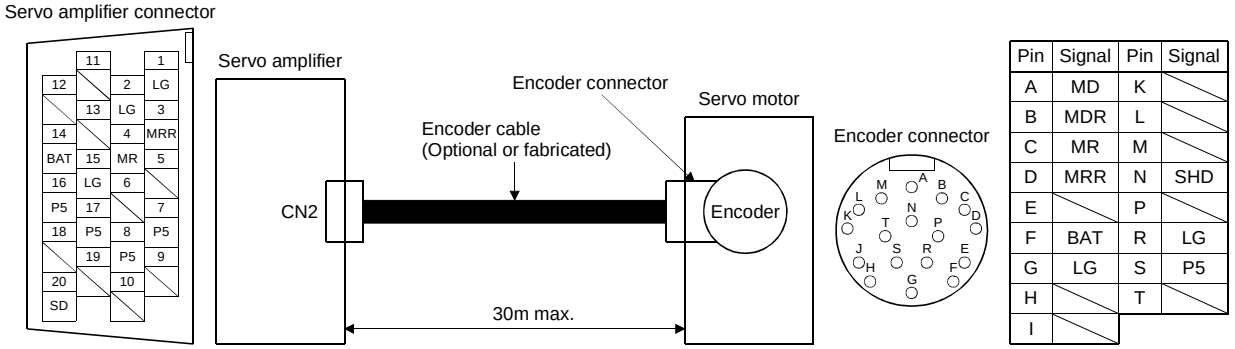
Type: MR-JHSCBL□M-□

Symbol	Cable Length [m]
2	2
5	5
10	10
20	20
30	30

Symbol	Specifications
L	Standard flexing life
H	Long flexing life

(b) Connection diagram

When fabricating a cable, use the recommended wire and encoder cable fabricating connector set given on Appendix 1.2 (1), and make the cable as shown in the following connection diagram. This connection allows you to fabricate an up to 30m length of cable including the encoder cable supplied to the servo motor.



Pin	Signal	Pin	Signal
A	MD	K	
B	MDR	L	
C	MR	M	
D	MRR	N	SHD
E		P	
F	BAT	R	LG
G	LG	S	P5
H		T	
I			

MR-JHSCBL2M-L, MR-JHSCBL5M-L, MR-JHSCBL2M-H, MR-JHSCBL2M-H

Servo amplifier side	Encoder side
10120-3000VE (connector)	MS3106B20-29S (plug)
10320-52F0-008 (shell kit)	MS3057-12A (cable clump)

P5	19	S
LG	11	
P5	20	
LG	12	R
MR	7	C
MRR	17	D
P5	18	
LG	2	
BAT	9	F
LG	1	G
SD	Plate	N

AWG24 used*1
(for less than 10m)

*1: AWG28 can be used for 5m or less.

MR-JHSCBL10M-L to MR-JHSCBL30M-L

Servo amplifier side	Encoder side
10120-3000VE (connector)	MS3106B20-29S (plug)
10320-52F0-008 (shell kit)	MS3057-12A (cable clump)

P5	19	S
LG	11	
P5	20	
LG	12	
P5	18	
LG	2	R
MR	7	C
MRR	17	D
BAT	9	F
LG	1	G
SD	Plate	N

AWG22 used
(for 10m to 30m)

MR-JHSCBL10M-H to MR-JHSCBL30M-H

Servo amplifier side	Encoder side
10120-3000VE (connector)	MS3106B20-29S (plug)
10320-52F0-008 (shell kit)	MS3057-12A (cable clump)

P5	19	S
LG	11	
P5	20	
LG	12	
P5	18	
LG	2	R
MR	7	C
MRR	17	D
BAT	9	F
LG	1	G
SD	Plate	N

AWG22 used
(for 10m to 30m)

(5) MR-ENCBL□M-H (Long flexing life product)

(a) Explanation of type

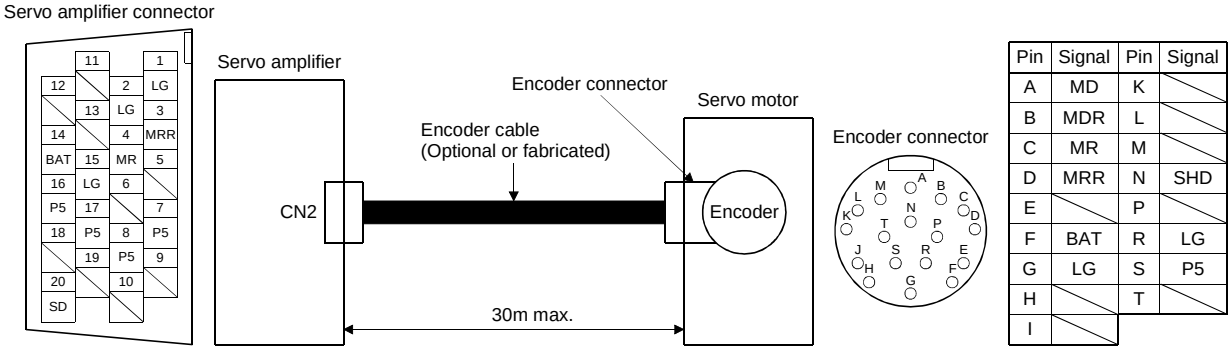
Type: MR-ENCBL□M-H

Long flexing life

Symbol	Cable Length [m]
2	2
5	5
10	10
20	20
30	30

(b) Connection diagram

When fabricating a cable, use the recommended wire and encoder cable fabricating connector set given on Appendix 1.2 (1), and make the cable as shown in the following connection diagram. This connection allows you to fabricate an up to 30m length of cable including the encoder cable supplied to the servo motor.

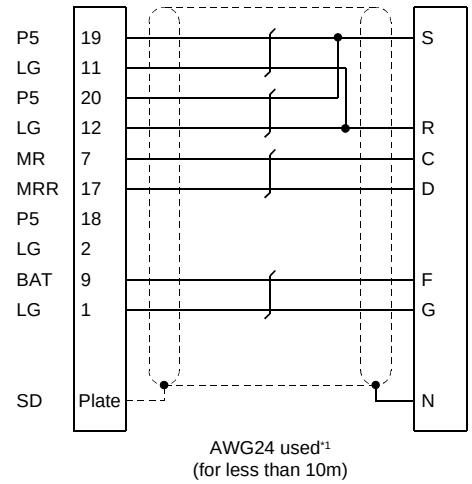


Pin	Signal	Pin	Signal
A	MD	K	
B	MDR	L	
C	MR	M	
D	MRR	N	SHD
E		P	
F	BAT	R	LG
G	LG	S	P5
H		T	
I			

MR-ENCBL2M-H
MR-ENCBL5M-H

Servo amplifier side
10120-3000VE(connector)
10320-52F0-008(shell kit)

Encoder side
MS3106A20-29S(D190)(plug)
CE3057-12A-3(D265)(cable clump)
CE02-20BS-S(back shell)



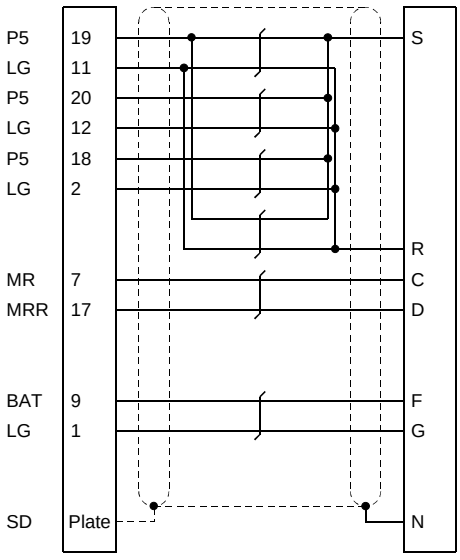
AWG24 used*1
(for less than 10m)

*1: AWG28 can be used for 5m or less.

MR-ENCBL10M-H to MR-ENCBL30M-H

Servo amplifier side
10120-3000VE(connector)
10320-52F0-008(shell kit)

Encoder side
MS3106A20-29S(D190)(plug)
CE-3057-12A-3(D265)(cable clump)
CE02-20BS-S(back shell)



AWG22 used
(for 10m to 30m)

(6) MR-JCCBL□M-L/MR-JCCBL□M-H

(a) Explanation of type

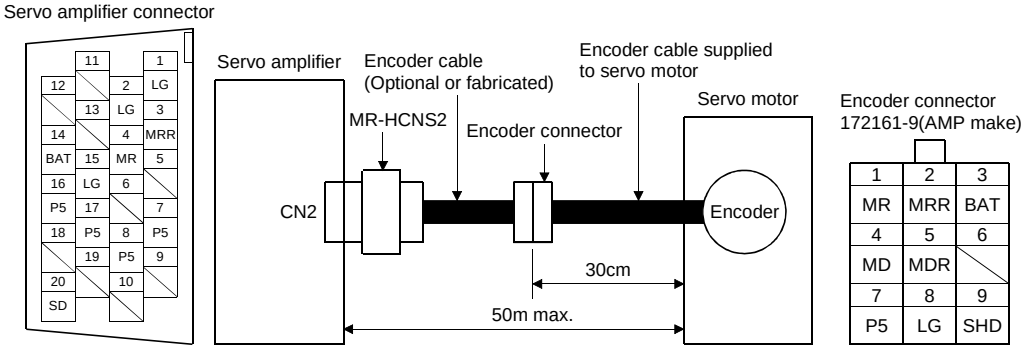
Type: MR-JCCBL□M-□

Symbol	Cable Length [m]
2	2
5	5
10	10
20	20
30	30

Symbol	Specifications
L	Standard flexing life
H	Long flexing life

(b) Connection diagram

When fabricating a cable, use the recommended wire and encoder cable fabricating connector set given on Appendix 1.2 (1), and make the cable as shown in the following connection diagram. This connection allows you to fabricate an up to 30m length of cable including the encoder cable supplied to the servo motor.



1	2	3
MR	MRR	BAT
4	5	6
MD	MDR	
7	8	9
P5	LG	SHD

MR-JCCBL2M-L, MR-JCCBL5M-L, MR-JCCBL2M-H, MR-JCCBL2M-H

Servo amplifier side 10120-3000VE (connector) 10320-52F0-008 (shell kit)		Encoder side 1-172161-9 (plug) 170359-1 (connector pin)
P5	19	7
LG	11	
P5	20	
LG	12	
P5	18	
LG	2	
		8
MR	7	1
MRR	17	2
MD	6	4
MDR	16	5
BAT	9	3
LG	1	
		*1
SD	Plate	9

MR-JCCBL10M-L to MR-JCCBL30M-L

Servo amplifier side 10120-3000VE (connector) 10320-52F0-008 (shell kit)		Encoder side 1-172161-9 (plug) 170359-1 (connector pin)
P5	19	7
LG	11	
P5	20	
LG	12	
P5	18	
LG	2	
		8
MR	7	1
MRR	17	2
MD	6	4
MDR	16	5
BAT	9	3
LG	1	
		*1
SD	Plate	9

MR-JCCBL10M-H to MR-JCCBL30M-H

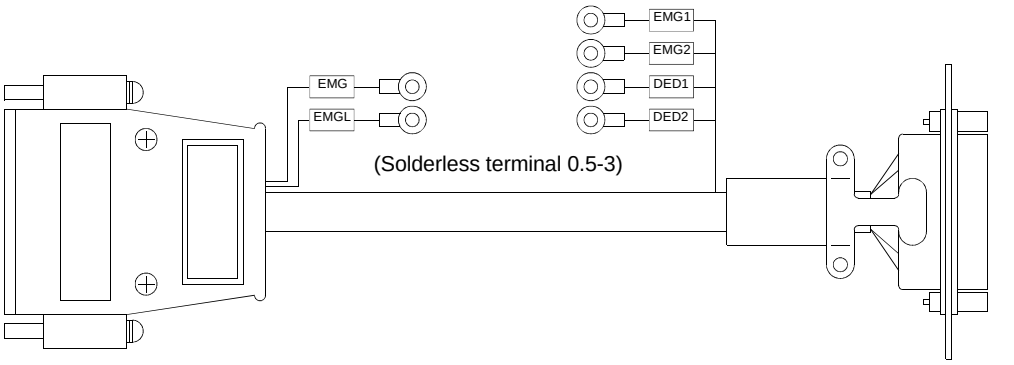
Servo amplifier side 10120-3000VE (connector) 10320-52F0-008 (shell kit)		Encoder side 1-172161-9 (plug) 170359-1 (connector pin)
P5	19	7
LG	11	
P5	20	
LG	12	
P5	18	
LG	2	
		8
MR	7	1
MRR	17	2
MD	6	4
MDR	16	5
BAT	9	3
LG	1	
		*1
SD	Plate	9

*1: Always make connection for use in an absolute position detection system.
Wiring is not needed for use in an incremental system.

Appendix 1.3 A31TU-E Teaching Unit Cable

(1) A31TUCBL03M cable

(a) A31TUCBL03M cable appearance



CPU module side A31TU-E side

(b) A31TUCBL03M cable connection details

Signal name	Pin No.
BA	3
BAL	16
CA	5
CAL	18
BB	2
BBL	15
CB	4
CBL	17
+5V	12
+5V	13
SG	7
+5V	24
+5V	25
SG	8
SG	20
AB	21
FG	1
EMG	22
EMGL	9

(Red)
(White)

(Red)
(White)
(Red)
(White)

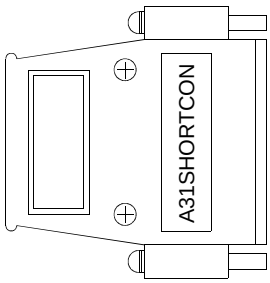
Signal name	Pin No.
BA	3
BAL	16
CA	5
CAL	18
BB	2
BBL	15
CB	4
CBL	17
+5V	12
+5V	13
SG	7
+5V	24
+5V	25
SG	8
SG	20
AB	21
FG	1
EMG1	22
EMG2	9
DED1	6
DED2	14

Case
CPU module side
Connector
17JE-23250-02(D8A)
Manufactured by DDK

A31TU-E side
Connector
DB-25SF-N
Manufactured by JAE

(2) A31SHORTCON short-circuit connector

(a) A31SHORTCON appearance



(b) A31SHORTCON internal wiring

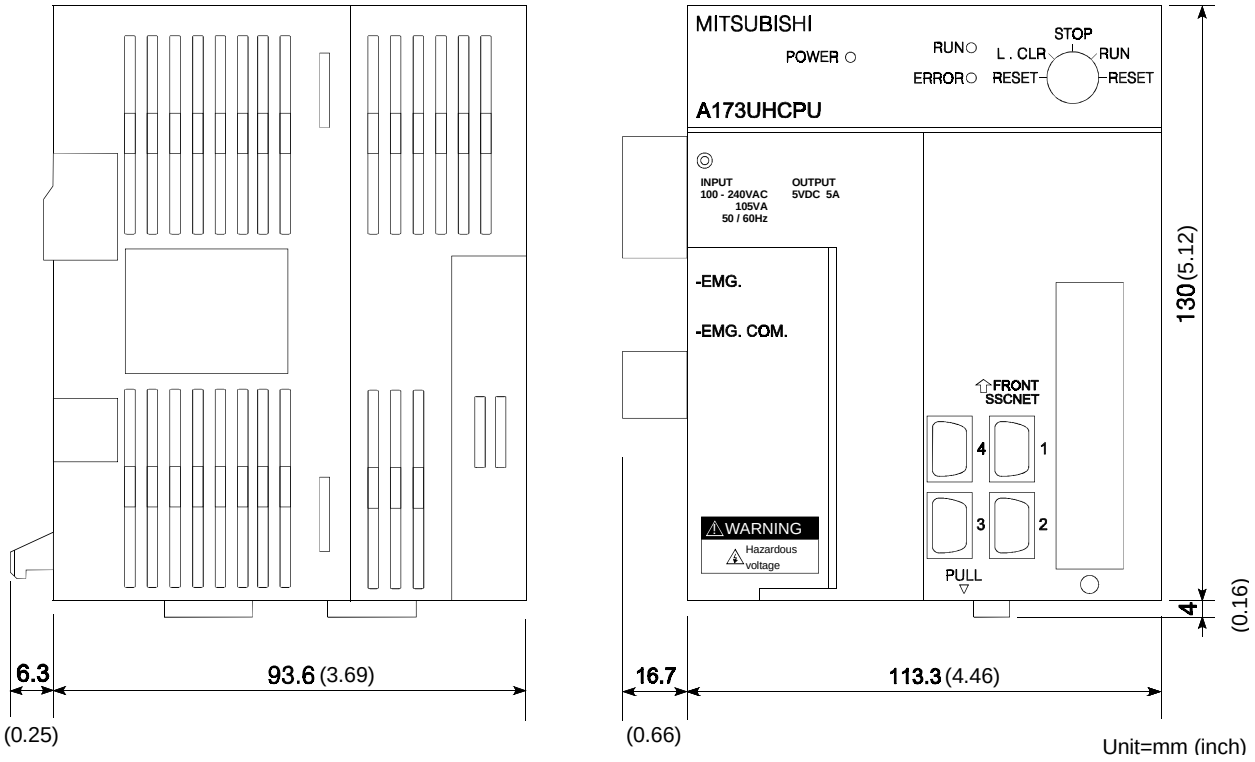
Signal name	Pin No.
BA	3
BAL	16
CA	5
CAL	18
BB	2
BBL	15
CB	4
CBL	17
+5V	12
+5V	13
SG	7
+5V	24
+5V	25
SG	8
SG	20
AB	21
FG	1
EMG1	22
EMG2	9
DED1	6
DED2	14

Connector
17JE-23250-02(D8A)
Manufactured by JAE

Appendix 2 Outside Dimensions

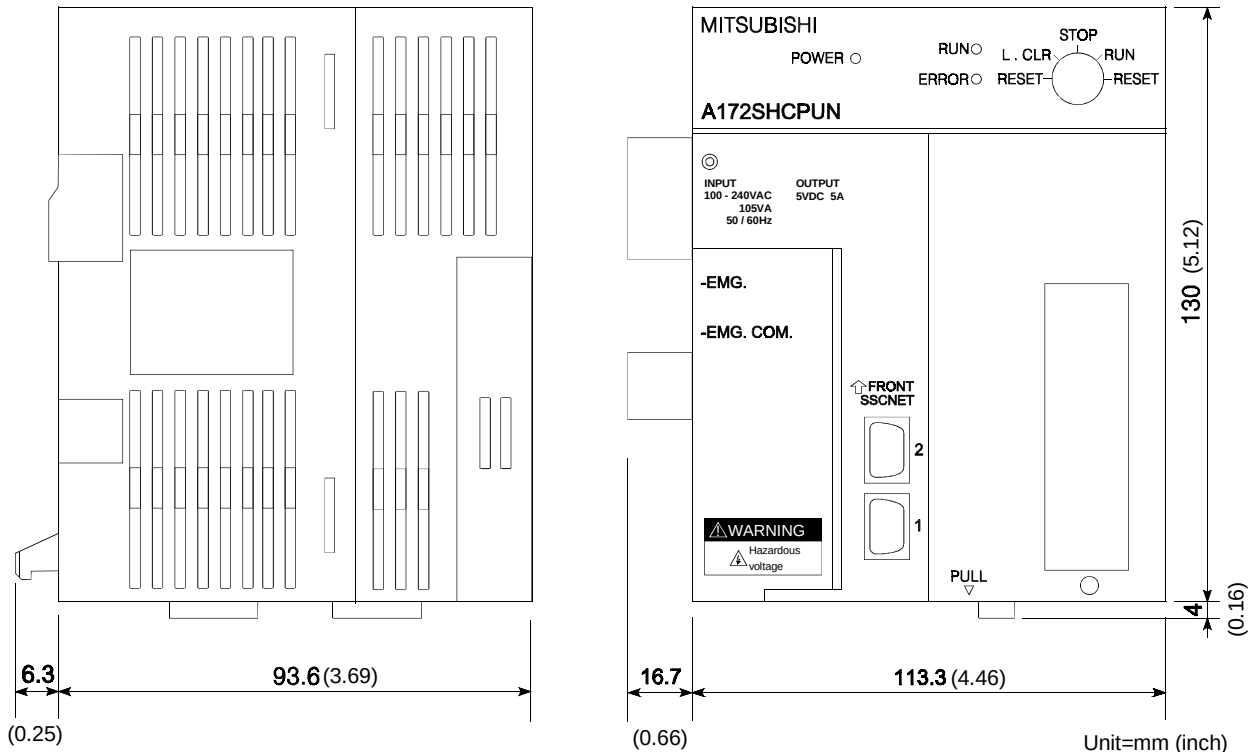
Appendix 2.1 CPU Modules

(1) A173UHCPU Module



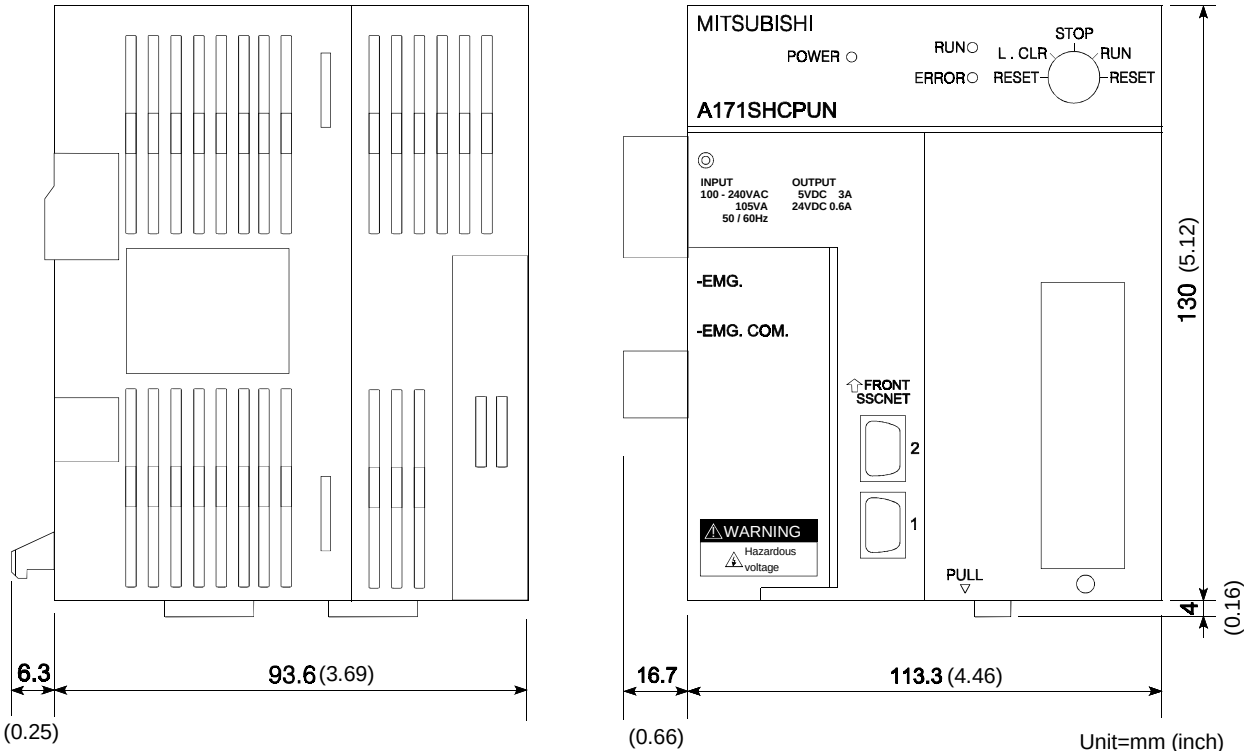
Unit=mm (inch)

(2) A172SHCPUN Module

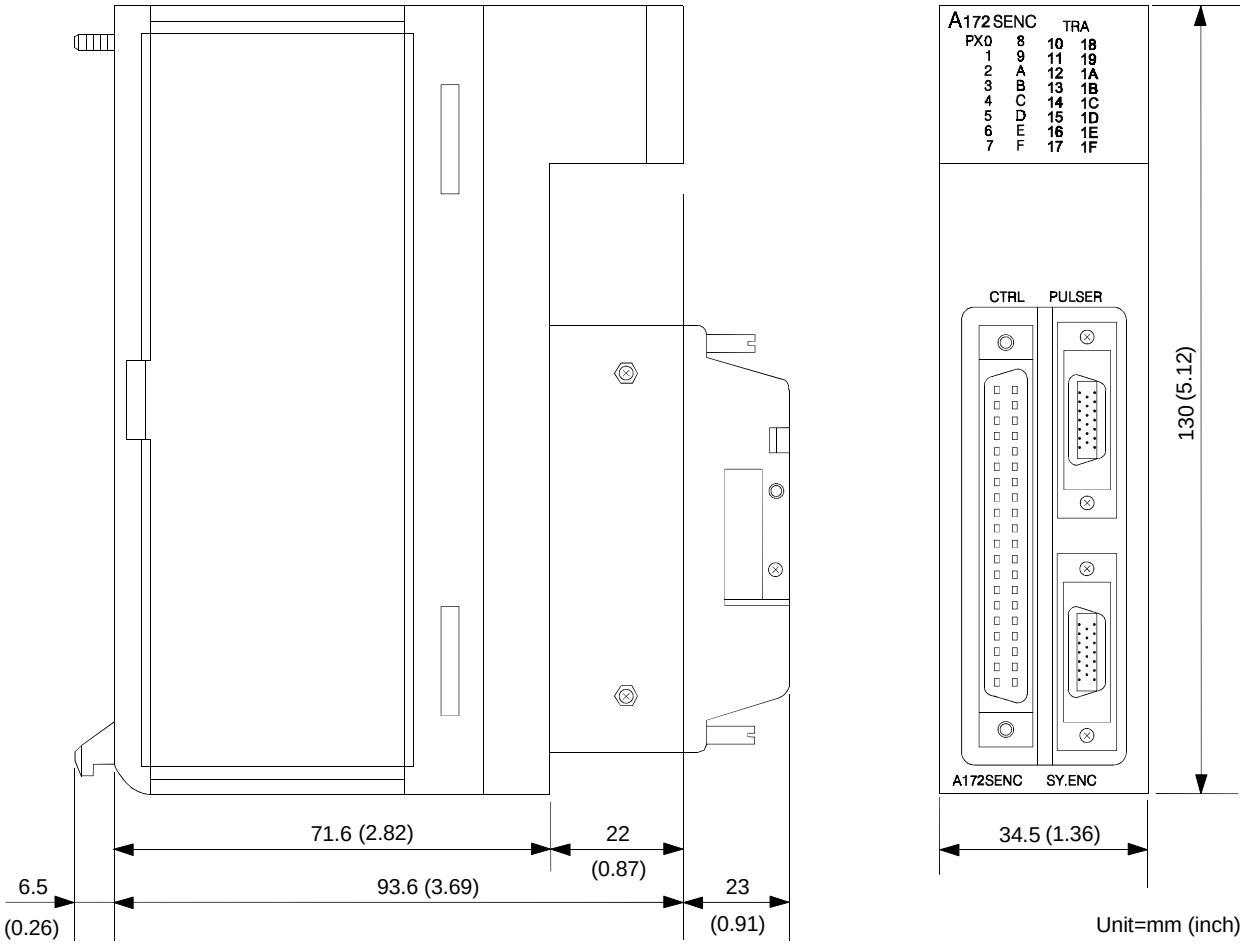


Unit=mm (inch)

(3) A171SHCPUN Module



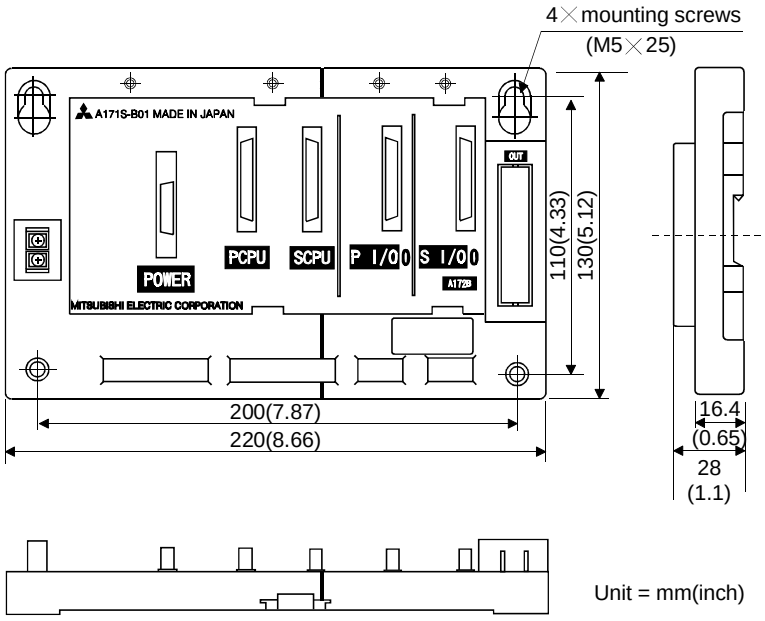
Appendix 2.2 Pulse Generator/Synchronous Encoder Interface Module (A172SENC)



Unit=mm (inch)

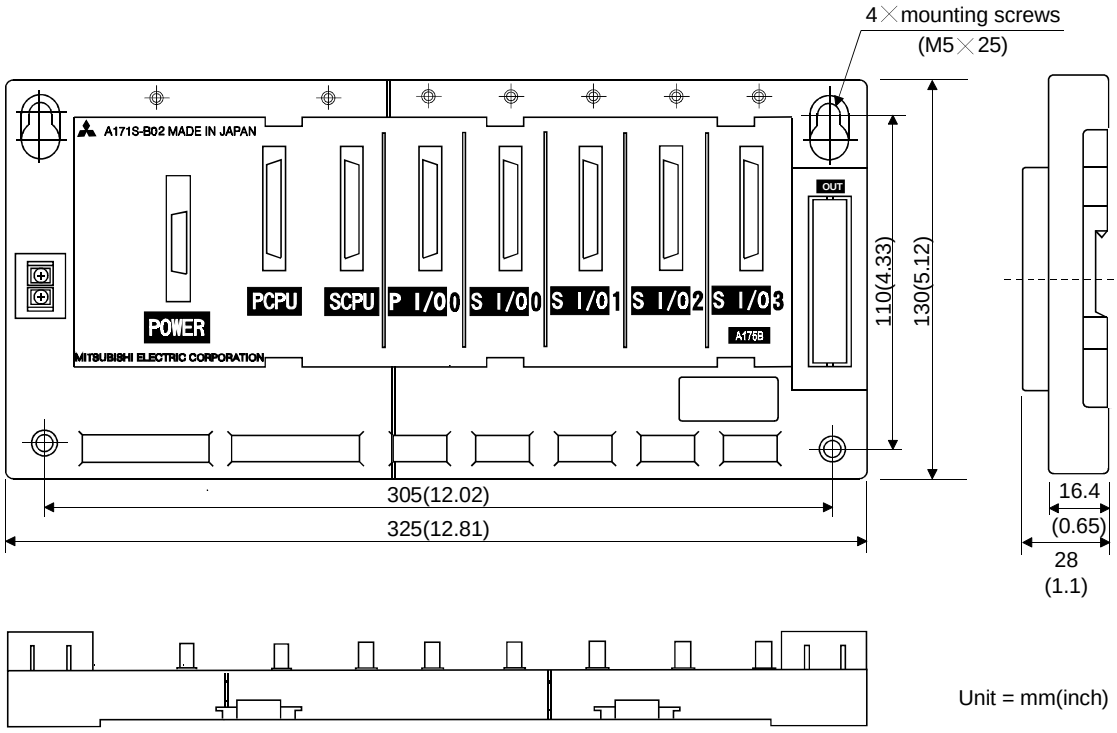
Appendix 2.3 Main Base Unit

(1) A172B main base unit



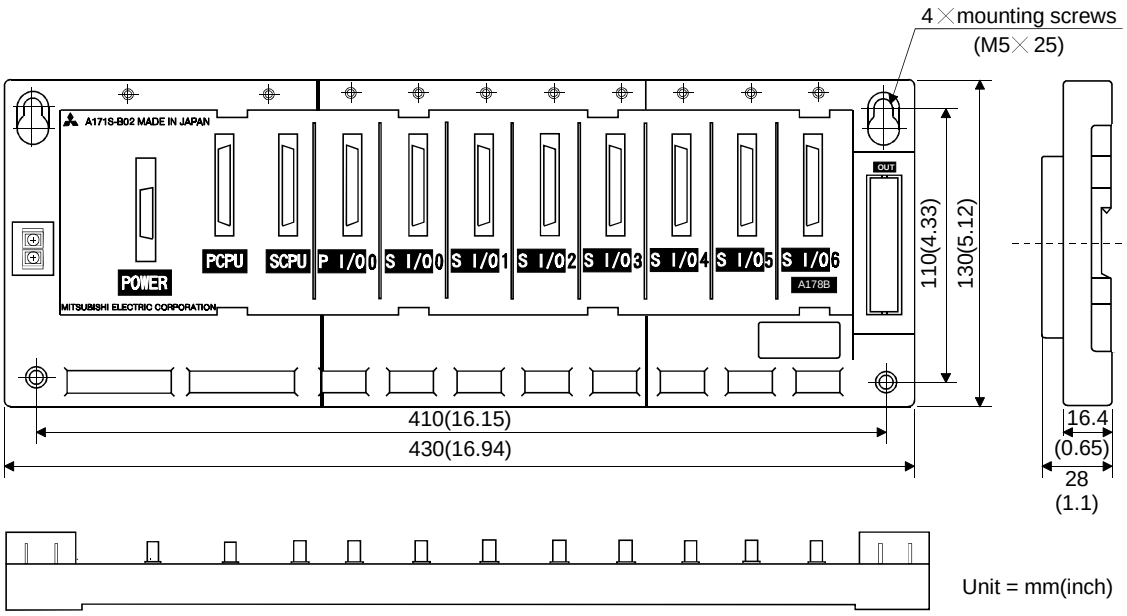
Unit = mm(inch)

(2) A175B main base unit



Unit = mm(inch)

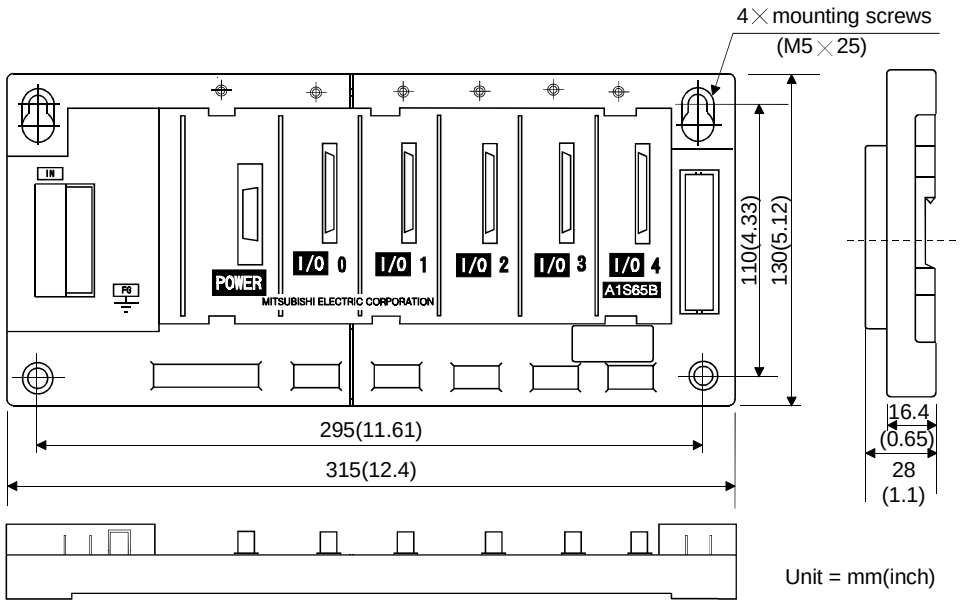
(3) A178B(-S1/S2/S3) main base unit



Unit = mm(inch)

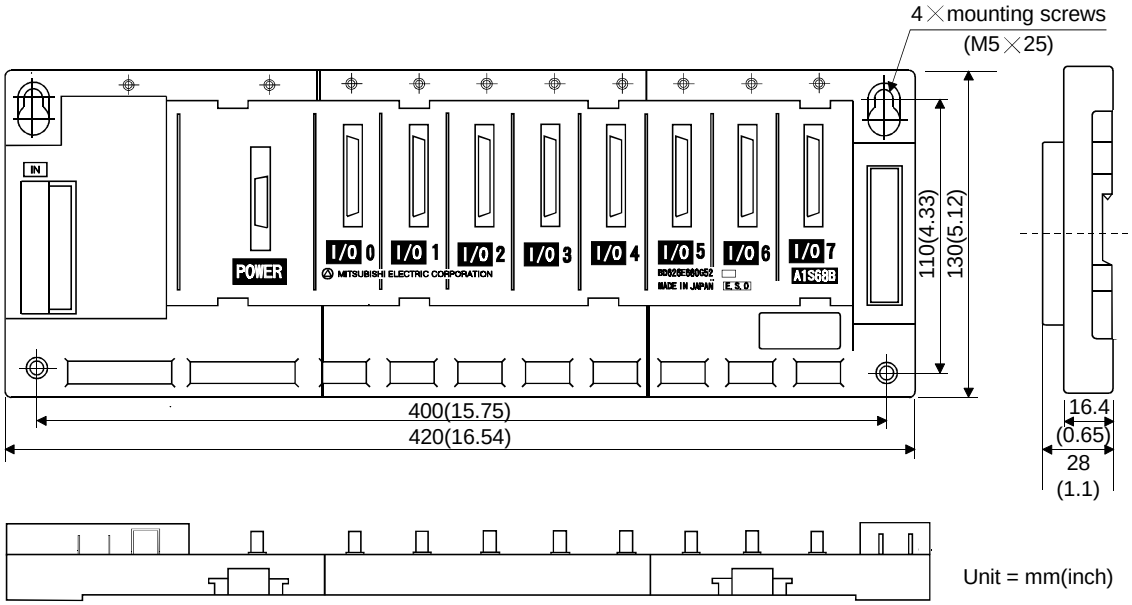
Appendix 2.4 Extension Base Units

(1) A1S65B extension base unit



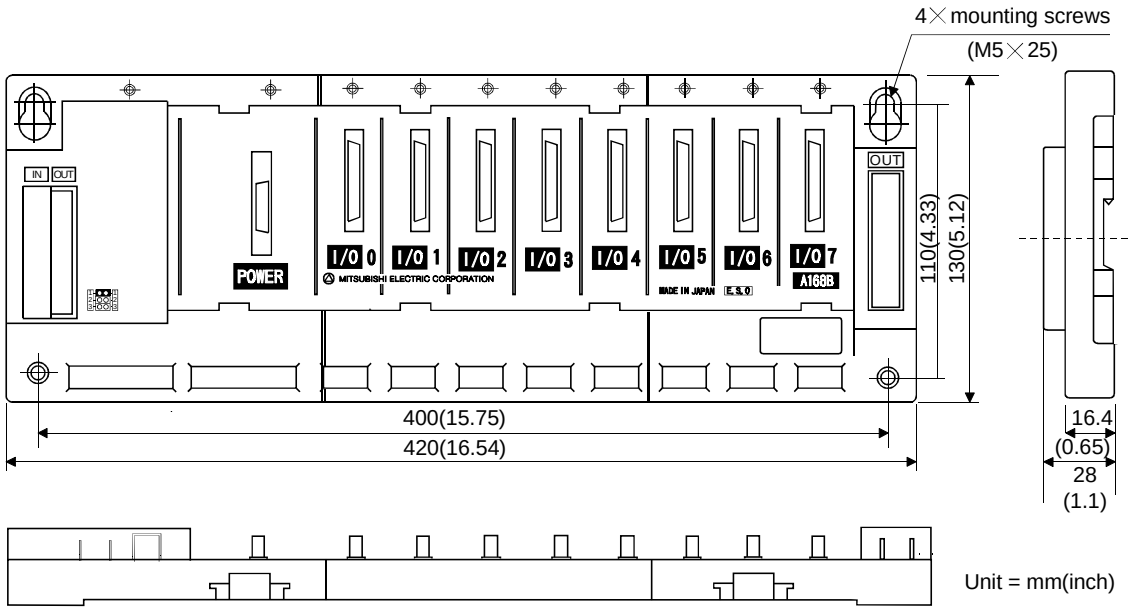
Unit = mm(inch)

(2) A1S68B extension base unit



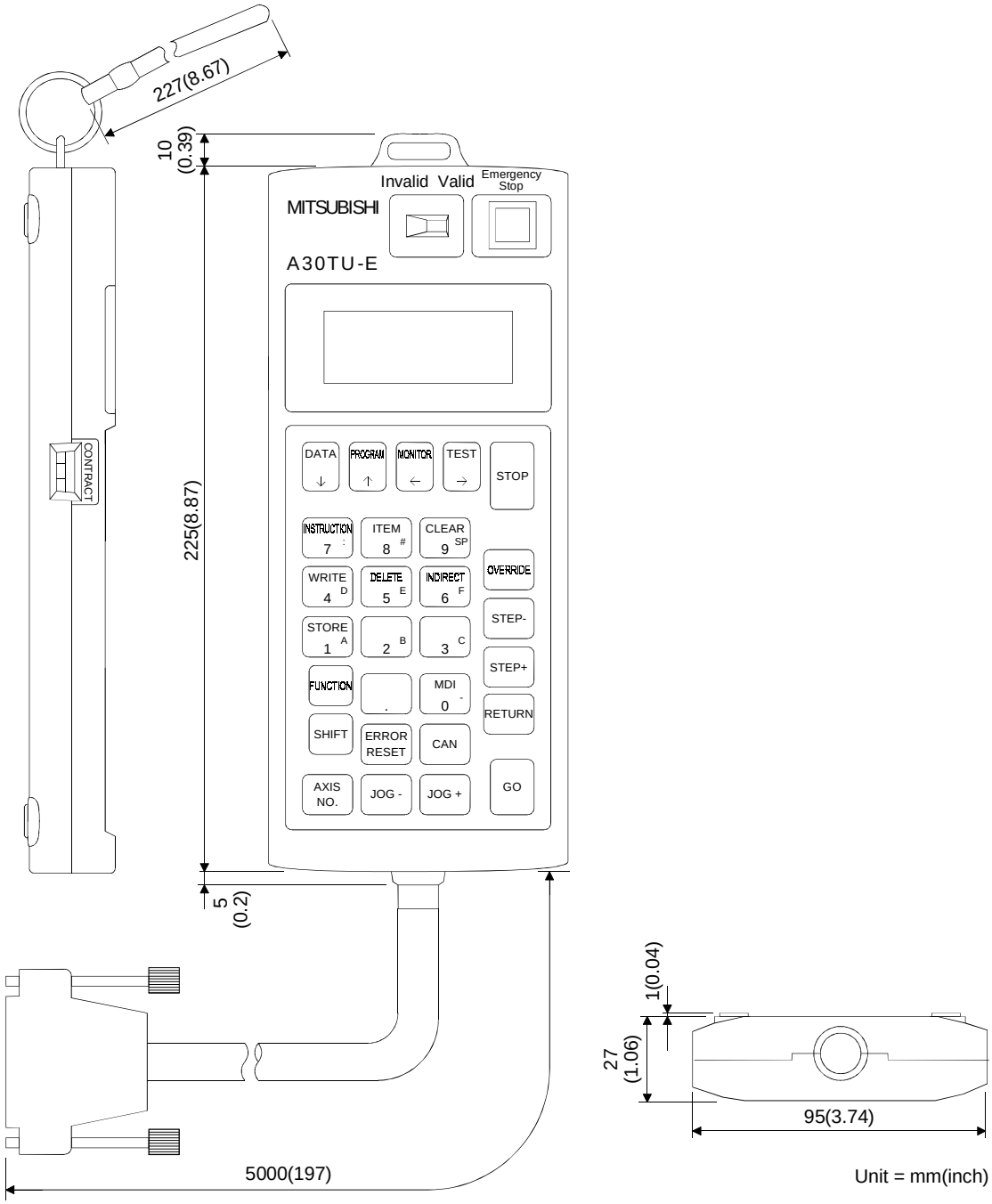
Unit = mm(inch)

(3) A168B extension base unit

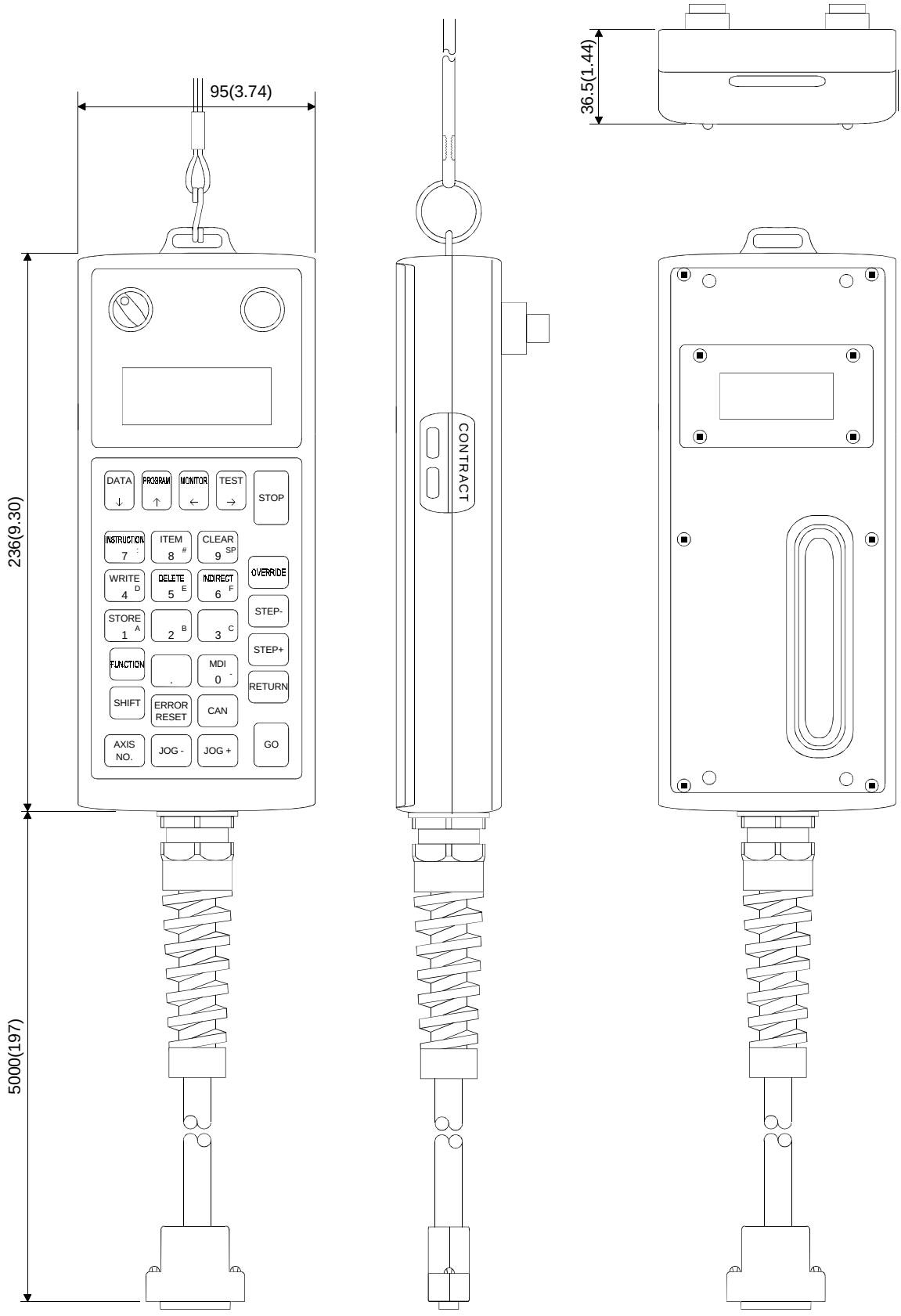


Appendix 2.5 Teaching Unit

(1) A30TU-E teaching unit



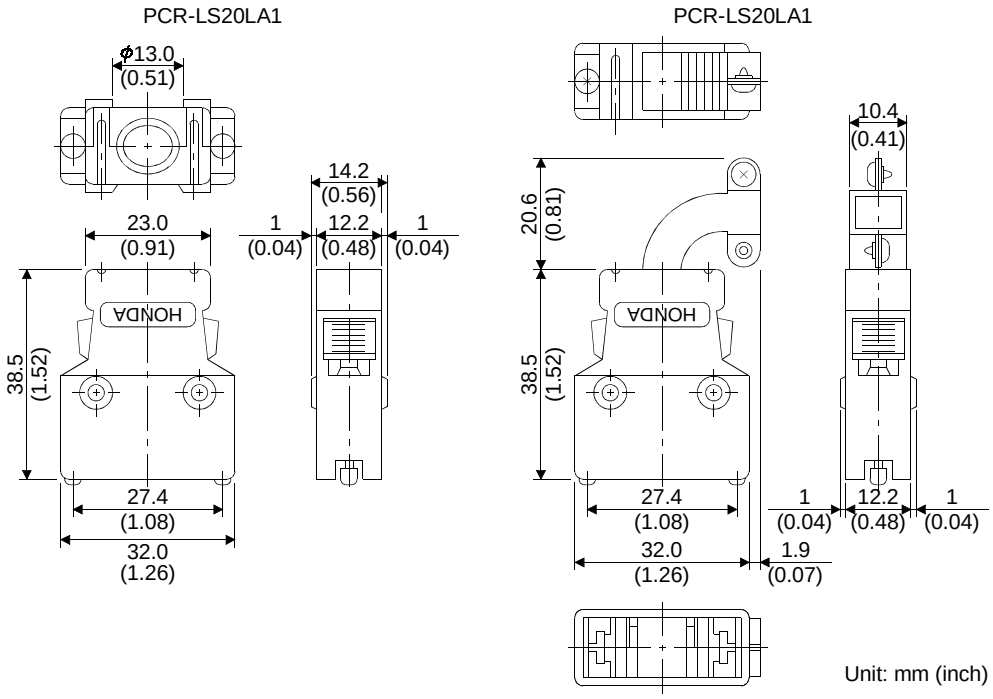
(2) A31TU-E Teaching Unit



Unit = mm(inch)

Appendix 2.6 Connector

(1) Honda Tsushin Kogyo make



Unit: mm (inch)

Number of Pins	Type	
	Connector	Case
20	PCR-S20FS (solder connection type)	PCR-LS20LA1
	PCR-S20F (insulation displacement type)	PCR-LS20LA1W

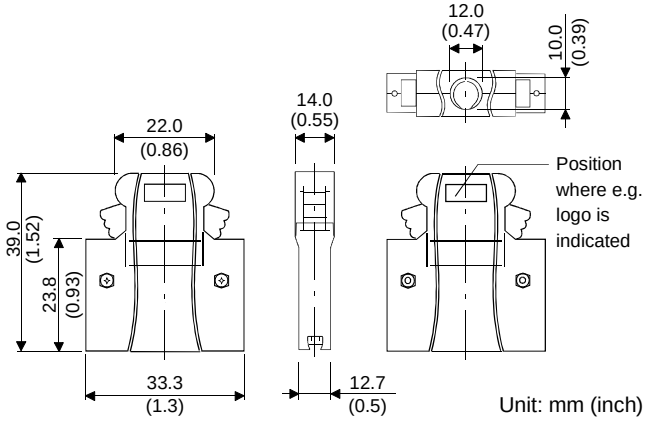
Insulation displacement tool: FHAT-002A

- PCR-S20F and PCR-LS20LA1W are not options.
  They should be prepared by the user.

(2) Sumitomo 3M make

(a) Solder connection type

Type Connector : 10120-3000VE
Shell kit : 10320-52F0-008



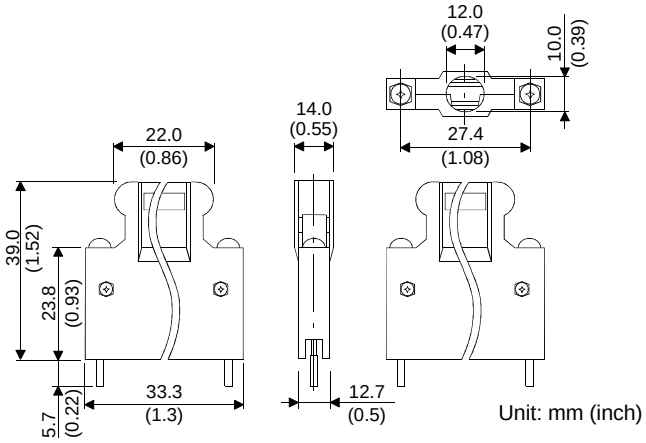
Unit: mm (inch)

(b) Threaded type

Type Connector : 10120-3000VE

Shell kit : 10320-52A0-008

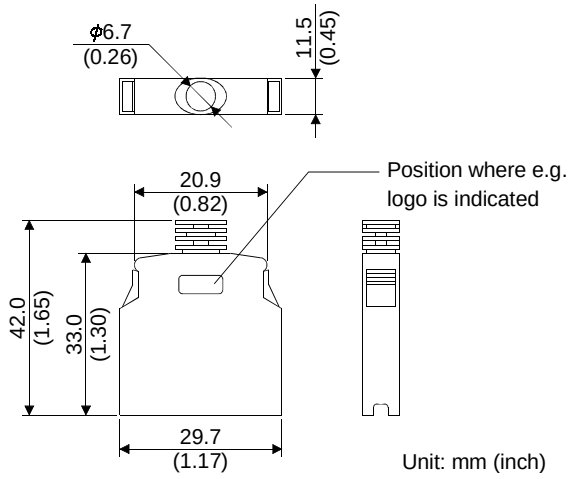
- These are not options and should be prepared by the user.



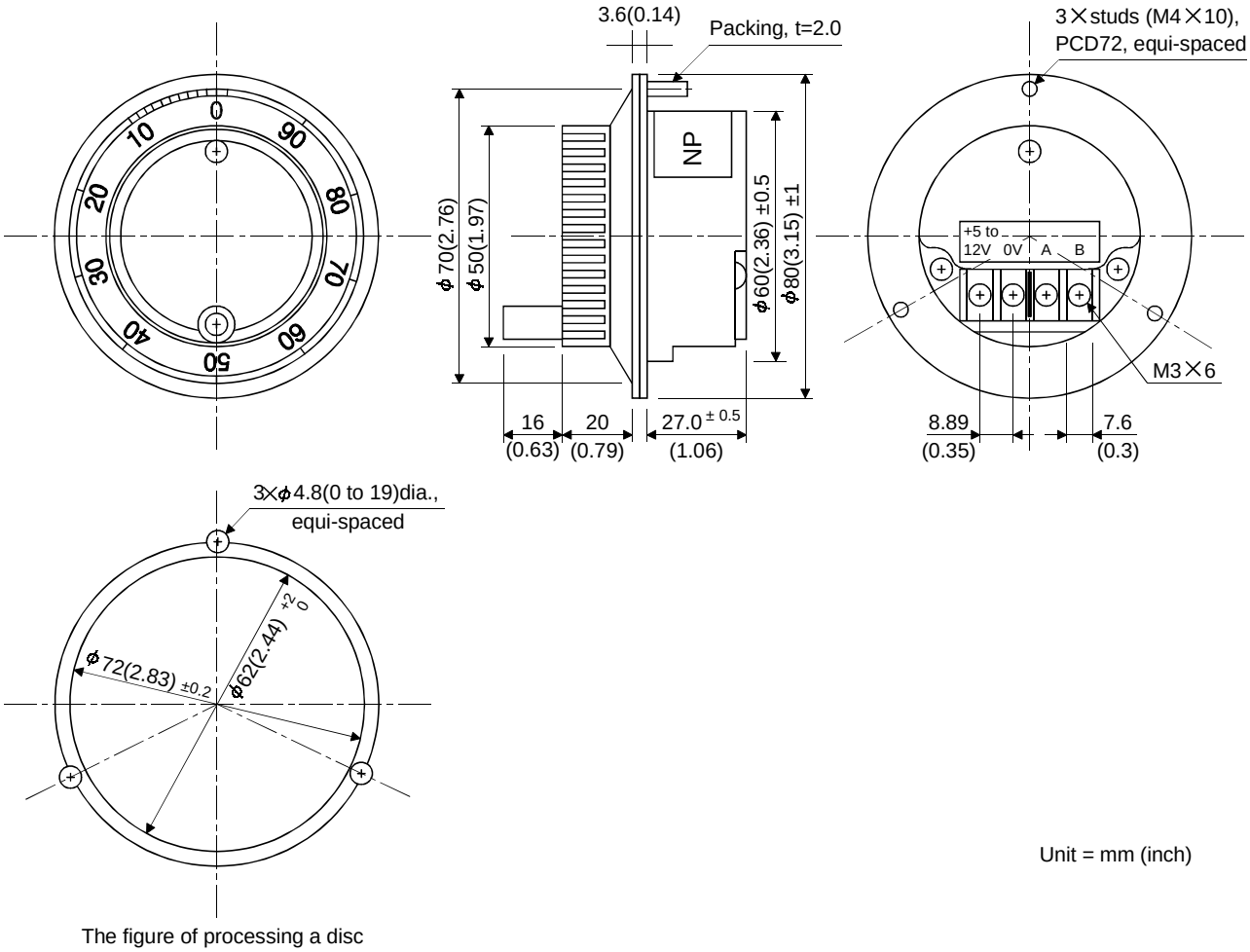
(c) Insulation displacement type

Type Connector : 10120-6000EL

Shell kit : 10320-3210-000

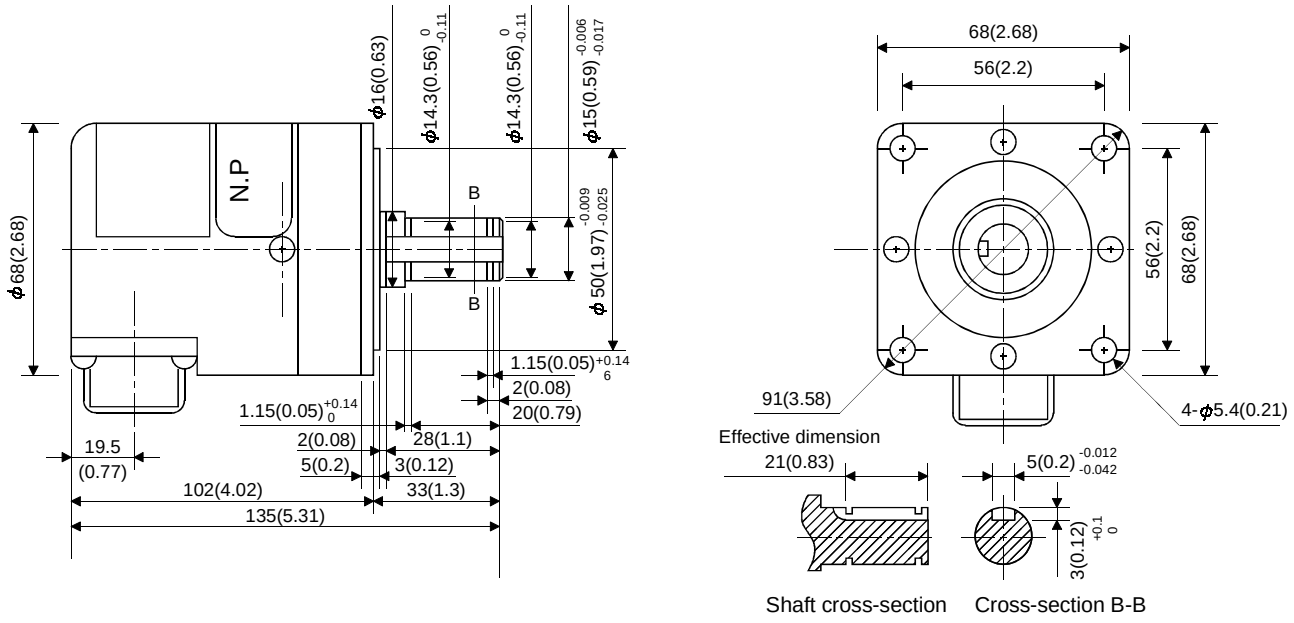


Appendix 2.7 Manual Pulse Generator Specifications



Item	Specification
Model name	MR-HDP01
Pulse resolution	25 PLS/rev (100 PLS/rev after magnigication by 4 in A172SENC
Output method	Open-collector output, output current = 20 mA max.
Supply voltage	4.5 to 13.2VDC
Current consumption	60 mA max.
Life	1,000,000 revolutions min (at 200 r/min).
Permitted axial loads	Radial load: 19.6 N max.
	Thrust load: 9.8 N max.
Operation temperature	-10 to 60°C
Weight kg (lb)	0.4 (0.88)
Max. rotational speed	Instantaneous: 600 r/min max.; normal: 200 r/min
Pulse signal format	2 signals: A phase, B phase, 90°phase difference

Appendix 2.8 Serial Absolute Synchronous Encoder Specifications



Keyway Dimensional Diagram

Unit = mm (inch)

Item	Specification
Model name	MR-HENC
Resolution	16384 PLS/rev
Transmission method	Serial communications (connected to A172SENC)
Direction of increasing addresses	Counterclockwise (viewed from end of shaft)
Protective construction	IP52 (dust-proof, oil-proof)
Permitted speed	4300 r/min
Permitted axial loads	Radial load: 98 N
	Thrust load: 49 N
Runout at input shaft tip	0.02 mm (0.00079 inch) max., 15 mm (0.59 inch) from tip
Recommended coupling	Bellows coupling
Permitted angular acceleration	40000 rad/s
Operation temperature	-5 to 55°C
Weight kg (lb)	1.5 (3.3)
Connecting cables	MR-HSCBL□M, where □ is replaced by the cable length: 2m (6.56 ft.), 5 m (16.4 ft.), 10 m (32.8 ft.), 20 m (65.6 ft.), 30 m (98.4 ft.)
Communications method	Differential driver/receiver conforming to RS422A
Transmission distance	30 m (98.4 ft.) max.

MITSUBISHI ELECTRIC CORPORATION

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NAGOYA WORKS : 1-14 , YADA-MINAMI 5 , HIGASHI-KU , NAGOYA , JAPAN

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